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Vol. 77, No. 1

Editors : J. C. Daniel, P. V. Bole & A. N. D. Nanavati

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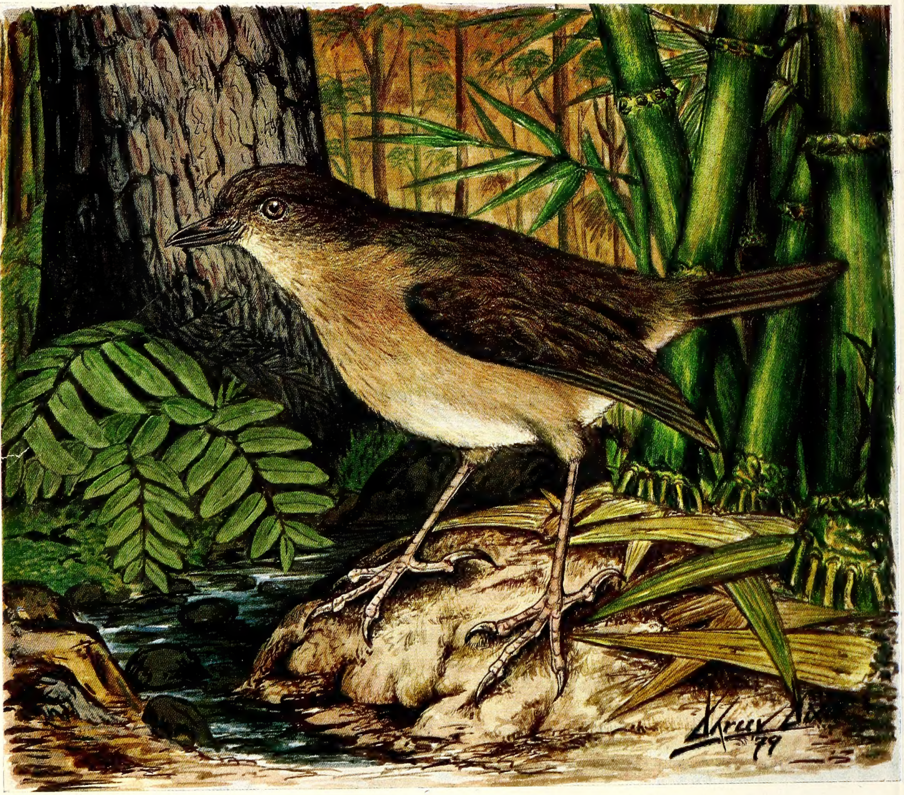

Brachypteryx cryptica sp. nov. from Tirap District, Arunachal Pradesh.

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A NEW SPECIES, AND A NEW SUBSPECIES OF BIRD FROM TIRAP DISTRICT, ARUNACHAL PRADESH, AND COMMENTS ON THE SUBSPECIES OF *STACHYRIS NIGRICEPS* BLYTH.[1]

S. DILLON RIPLEY[2]

(*With a coloured plate*)

A new species of shortwing (Turdinae) is described from five specimens collected in dense evergreen rain forest along the Noa Dihing River, eastern Arunachal Pradesh. The new form is close in appearance to *Brachypteryx hyperythra,* but somewhat larger, the dull female plumage (in both sexes), more streaked, and lacking the concealed white eyebrow patch found in all other species of the genus except for *B. major* of South India. A new subspecies of Scimitar Babbler (*Pomatorhinus*), is also described from the same locality. Comments on the geographical races of Blackthroated Babbler (*Stachyris*) are given. (Both latter genera belong to Timaliinae).

During a second survey trip to Arunachal Pradesh, my wife and I were priviledged to join Dr. Sálim Ali, and colleagues from the Bombay Natural History Society, on a month's camp along the Noa Dihing River on the border of the Namdapha wildlife reserve.

By the use of mist nets we secured and observed many species of birds, otherwise almost impossible to record. The extremely dense vegetation, a characteristic of mature, unopened rainforest was penetrated only by a rough dirt track, accessible, at some seasons, by jeep. Heavy rain, beginning on March 15, greatly limited our observations. However, we were fortunate to obtain a small series of the following new species:

Brachypteryx cryptica sp. nov.
Enigmatic Shortwing

Holotype: United States National Museum of Natural History, no. 583152, adult male from 40-mile camp (Bhimraj camp), east of Miao, Noa Dihing River road (27° 40′ N., 97° E. approx.), elevation 820 m (2650 ft.);

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[1] Accepted April 1980.

[2] Smithsonian Institution, Washington, D.C. 20560, U.S.A.

collected 23 March, 1979, by S. Dillon Ripley, field number 254.

Diagnosis: in size and coloration nearest to *Brachypteryx hyperythra*, the little-known Rustybellied Shortwing, recorded from Sikkim, Arunachal Pradesh (in Subansiri Dist.), Assam and Nagaland. Male plumage in the adult of *hyperythra* is strongly dimorphic, dark blue upperparts, blackish lores and sides of throat, concealed white supercilium, ferruginous below. The female is olive-brown above and pale ferruginous below with the center of the belly whitish. In contrast males and females of *cryptica* differ from the female plumage of *hyperythra* by somewhat lighter brown upperparts, Russet rather than Olive-brown (cf. Smithe, 1975), with noticeable buff shaft-streaks on the forehead and forecrown producing a streaked effect. The feathers of the nares, anterior to the eyes, are coloured creamy-buff, giving the suggestion of a dull but distinct light patch, totally unlike the uniform olive-brown tone of *hyperythra*. Below, this species is pale creamish amber-brown, ranging to clay brown on the throat and upper breast, in contrast to the dark cinnamon of *hyperythra*. The shafts of the feathers of the breast in *cryptica* are margined at the ends with pale olive-brown, giving a streaked effect. Lower down the breast pales to buff and the abdomen is dull whitish, the flanks pale olive-brown, rather than dark as in *hyperythra*, and the undertail coverts warm buff rather than reddish-cinnamon. The effect produced is of a paler bird beneath, buff to whitish, rather than ferruginous to creamy.

Stuart Baker (1933) writes of males of two species of *Brachypteryx* as not donning the slaty-blue upperparts of adult dress, and still being in breeding condition, in the eastern part of the range, namely the hills of Nagaland and the Patkoi Range in Arunachal. Whether these birds are fully adult and maintain a hen plumage throughout life is not known. Such birds could come into breeding condition in the first year, assuming dimorphic adult plumage later, in the second year?

The specimens of *cryptica* collected shed no light on the presence of dimorphism in the species. One male has somewhat enlarged gonads (holotype). At least it can be maintained that this species is distinct based on these specimens obtained. If the range is as given, namely the Patkoi foothills of eastern Arunachal Pradesh, it may be that the species has progressed a step further than its congeners, and supressed a dimorphic male plumage?

From the other *Brachypteryx* species, as the Key in the INDIAN HANDBOOK indicates (1973, *8*: 204), *cryptica* differs in the creamy umber brown throat and underparts rather than white in *leucophrys*, warm brown in *montana*, or the chestnut upperparts and vermiculated underparts in *stellata*. It differs in size also from these species, being close only to *hyperythra*.

Distribution: Known only from the type locality.

Measurements: See Table 1.

Remarks: The above measurements indicate that this new species is a larger bird than *hyperythra*, with a longer tail, (tail-wing index of males .80 versus .07 for *hyperythra*), with a somewhat stouter, slightly longer bill compared to the latter species. No field observations were possible with these netted birds, often collected in heavy rain.

Pomatorhinus ferruginosus namdapha,
subsp. nov.

Holotype: United States National Museum of Natural History, no. 583153, adult male, from 40-mile camp (Bhimraj camp), east of

TABLE 1

MEASUREMENTS OF *Brachypteryx cryptica* AND *hyperythra*

	Sex	Wing	Tail	Tarsus	Culmen	Middle Toe	Bill Width	Weight
B. cryptica	♂ (Type)	66 mm.	53	28.5	16.5	17	5	20.75 gr.
	♂ (1)	67	54	30	17.5	17	5	20.75
	♀ (3)	62-66	45	27.5-28.5	16.5	15-16.5	5-5.5	20.00 (1)
B. hyperythra	♂ (6)	62-66.5 (63.5)	43-48 (44.5)	28.5-30 (29.2)	14.5-16 (15)	13.5-17 (15)	4-5.5	—
	♀ (2)	61, 63	40, 41.5	27.5, 28.5	15, 15.5	13, 14	3, 5.5	—

Miao, Noa Dihing River Road (27° 40′ N., 97° E. approx.), March 22, elevation 820 m. (2650 ft.), collected by S. Dillon Ripley, field number 251.

Diagnosis: differs from *Pomatorhinus ferruginosus ferruginosus* of east Nepal, Sikkim, Bhutan and western Arunachal Pradesh in Kameng and Subansiri districts, in lacking the black cap and rusty red patch posterior to the nares at the commencement of the white supercilium, and the bright ferruginous lower throat, breast, and center of abdomen.

From *P. f. formosus* of the Garo, North Cachar, Naga and Manipur Hills, this population differs in having the crown dark olive-brown rather than russet, and in darker olive-brown back, the post-nasal spot at the commencement of the white supercilium is noticeably richer; whitish tinted with cinnamon-rufous, rather than whitish tinted with salmon. The lower throat, abdomen and breast is lighter than *formosus*, cinnamon, rather than dull dark cinnamon to pale cinnamon-rufous.

Compared to *P. f. stanfordi* of northeastern Burma (as well as *albogularis* of eastern Burma and northwest Thailand) this population differs by dark olive-brown rather than tawny brown back, a richer cinnamon-rufous post-nasal spot rather than a pale whitish area, tinted at its lower margin with creamy buff, and by dark dull cinnamon to pale cinnamon-rufous rather than dark yellowish-buff underparts.

In measurements all these populations seem rather overlapping;

ferruginosus 5 o; wing 85-92; tail 98-105; culmen 29-31.5 mm.

namdapha 2 ♂, ♀; wing 90-93; tail 101, 104; culmen 29-30.

formosus ♂, 4 ♀, o wing 89-97; tail 103-112; culmen 29-31.

stanfordi 2 ♂, ♀, o wing 92-95; tail 99-111; culmen 29-32.

Weight; *namdapha,* 2 ♂ 47, 50, ♀ 44 gr.

There seems to be no difference in colour of the eyes, bill or legs.

Remarks: On different occasions in mid-March, individuals of this shy and elusive scimitar babbler were heard calling in the dense wet evergreen forest, but seen only with the greatest difficulty. The type specimen was in breeding condition (testes enlarged).

Stachyris nigriceps Blyth

The collection of additional fresh specimens of *Stachyris nigriceps* in eastern Arunachal Pradesh reveals that, although my descriptions of *S. n. spadix* (1948) and *S. n. coei* (1952) had a certain validity, I was unwise to distinguish these representatives of a cline as separate in the absence of intermediate geographic specimens.

Stachyris nigriceps, the Blackthroated Babbler (type locality, Nepal), of which I have examined many specimens, has a tendency to a black throat broadly or narrowly margined with white on the individual feathers. The ear coverts tend to be dark brown, almost blackish brown in some cases. As one examines specimens from farther east along the Himalayas into Arunachal Pradesh (specimen from Kameng district, 1978) east of Bhutan, the throat becomes more uniformly blackish, lacking the whitish streaks or feather margins, until, crossing the Dihang (the main Brahmaputra channel through the mountains), the final outpost, namely the Mishmi Hills of Lohit district, the type locality of *coei* is reached. Here the throat is nearly black, and the ear coverts are similarly dark, blackish brown. I feel that this population really does represent a contiuous cline, and that, therefore, the separation of a named population, *coei,* is unjustified.

Stachyris n. spadix (Laisung, north Cachar) was separated by myself (1948) from *nigriceps* as having a dark blackish-gray unstreaked throat and by having the ear coverts lighter in colour, brown, approaching burnt-umber. From *S. n. coltarti* (Margherita) this population was alleged to differ by having ear coverts brown rather than rufous-brown. The new series collected by us in Tirap district northeast of Margherita belong of course geographically with *coltarti,* (Harington, 1913) having warm-brown to rufous ear coverts, and unstreaked throats, but they are close enough in the colour of the ear coverts to specimens from the Garo Hills on the one hand and to those from northeastern Burma and northern Thailand on the other, to render their separation from *spadix* superfluous. There is a continuous cline towards darker ear coverts and slightly darker upper and lower parts, west to east as one examines specimens from the northern Patkoi Hills and east of Margherita, but these new specimens from Tirap district of Arunachal Pradesh have reddish brown ear coverts, rather than the blackish brown ear coverts of specimens to the north, in Lohit district.

Weights of this series in March are variable:

♂ (testes slightly enlarged, mid-March at 808 m altitude) 9.5 gr.
2♂ (testes enlarged, March 6, at 290 m altitude) 13.5 gr.
♀ (non-breeding, March 6, at 290 m altitude) 13.5 gr.

A single wintering male (Jan. 27) from Kameng weighed 22 g, 5 g heavier than specimens from Nepal, listed in the HANDBOOK (1971, *6*, p. 175). Presumably this difference is explained by fat deposition at that season.

In my judgement then, number 1215 of the HANDBOOK (1971, *6*: 174-177). *Stachyris nigriceps coei* Ripley, should be listed as a synonym of no. 1214, *Stachyris nigirceps nigriceps* Blyth, the range of no. 1214 to include the Lohit district (Mishmi Hills) of Arunachal Pradesh. Number 1216 *Stachyris nigriceps spadix* Ripley, should be placed as a synonym of no. 1217 *Stachyris nigriceps coltarti* Harington, and the range of the latter should thus include Assam, Mizoram, Meghalaya south to Bangladesh hills, the Chittagong region, Burma and northern Thailand in the lower hills.

ACKNOWLEDGEMENTS

In addition to the Arunachal Pradesh Government authorities; Shri R. Haldipur, Lieut. Governor, Shri Thangam, Chief Conservator of Forests, and Shri P. P. Malhotra, Shri D. P. Borah, and Shri B. K. Barua of the Forest Department, we are deeply grateful to the then Minister of Agriculture and Forests, Shri Surjit Singh Barnala, and the present Wildlife Department chief, Shri Nalni Jayal, for their support and encouragement. These senior officers gave unstintingly of their courtesy, cooperation and willing support. Without their help, these important records could not have been obtained. I thank the authorities of the American Museum of Natural History, British Museum (Natural History), and the Bombay Natural History Society for their gracious loan of comparative material in their care.

REFERENCES

ALI, S., AND RIPLEY, S. D. (1971 & 1973): Handbook of the Birds of India and Pakistan. Vol. 6; Vol. 8. Oxford Univ. Press, Bombay, New Delhi.

HARINGTON, H. H. (1913): Description of *Stachyris nigriceps coltarti*. *Bull. Brit. Orn. Club 33*: 61.

RIPLEY, S. D. (1948): A New Race of the Black-throated Babbler. *Bull. Brit. Orn. Club. 68*: 89.

——————— (1952): A New Race of Black-Throated Babbler from Assam. *Postilla,* Yale Peabody Museum, No. 14: 2.

SMITHE, F. B. (1975): Naturalist's Color Guide. Amer. Mus. Nat. Hist., New York.

STUART BAKER, E. C. (1933): The Nidification of the Birds of the Indian Empire. 2: 2. Taylor and Francis, London.

FRESHWATER ALGAE OF DAVANAGERE AND RAICHUR OF KARNATAKA STATE, INDIA[1]

U. D. Bongale[2] and S. G. Bharati[3]

(*With nine plates*)

In continuation of the studies made on fresh water algae of Karnataka, the present paper deals with the fresh water algae from Davanagere. The diatoms which were excluded in the earlier report on the algae of Yaragera lake, Raichur (Bharati and Bongale 1975) have also been included in this paper.

Algae were collected from Bathi lake of Davanagere in February 1975 and preserved in 4% formaldehyde for further observations. Camera lucida sketches were made for the identification.

CYANOPHYCEAE

Gloeothece membranacea (Rabenh.) Bornet (Pl. I, Fig. 1) Desikachary P. 128. Cells without sheath 3.5 to 5.0 μ broad, 5.0 to 8.5 μ long, bluegreen, sheath unlike the type is yellow to brownish.

Aphanocapsa banaresensis Bharadwaja (Pl. I, Fig. 2). Desikachary p. 133, Pl. 22, Fig. 8. Cells bluegreen, granulated, 4.5 to 6.0 μ diameter. Differs from the type in being much smaller and also sheath not hyaline, but yellowish.

Myxosarcina burmensis Skuja (Pl. I, Fig. 3.) Desikachary p. 178, Pl. 32, figs. 20-22. Cells closely packed, bluegreen, 1.5 to 2.0 μ in diameter, little smaller than the type. Colonies very small 20-25 μ in diameter.

Spirulina laxissima West, G. S. (Pl. I, fig. 4.) Desikachary p. 196, Pl. 36, fig. 5. Trichome bluegreen, nongranular, 2.5 to 3.0 μ broad, spirals upto 10 μ broad, 12 to 20 μ distant from each other. Trichomes broader than the type.

Oscillatoria curviceps Ag. ex Gomont (Pl. I, fig. 5.) Desikachary p. 209, Pl. 38, fig. 2. Thallus bluegreen to brown, trichomes bent at the apices, not spirally coiled, 9.0 to 12.0 μ broad, upto 1/3 as long as broad, cross walls very thick, end cell rounded. Little smaller than the type.

O. irrigua (Kutz.) Gomont (Pl. I, fig. 6.) Desikachary p. 224, Pl. 42, figs. 7, 9. Trichomes 3.5 to 5.0 μ broad. Cells nearly as long as broad, granulated. Much smaller than the type.

O. obscura Bruhl et Biswas (Pl. I, fig. 7). Desikachary p. 207. Trichomes 4.0 to 5.0 μ broad. Cells granulated, unlike the type trichome is not attenuated at the apex.

O. princeps Vaucher ex Gomont (Pl. I, fig. 8 a, b.) Desikachary p. 210, Pl. 37, figs. 1, 10, 11, 13, 14. Trichomes bluegreen, slightly attenuated and bent at the apices, cells 1/8 to ¼ as long as broad, end cells flatly rounded, slightly capitate with thickened outer membrane 12 to 35 μ broad.

O. subtilissima Kutz. (Pl. I, fig. 9) Desikachary p. 215. Cells bluegreen, granulated,

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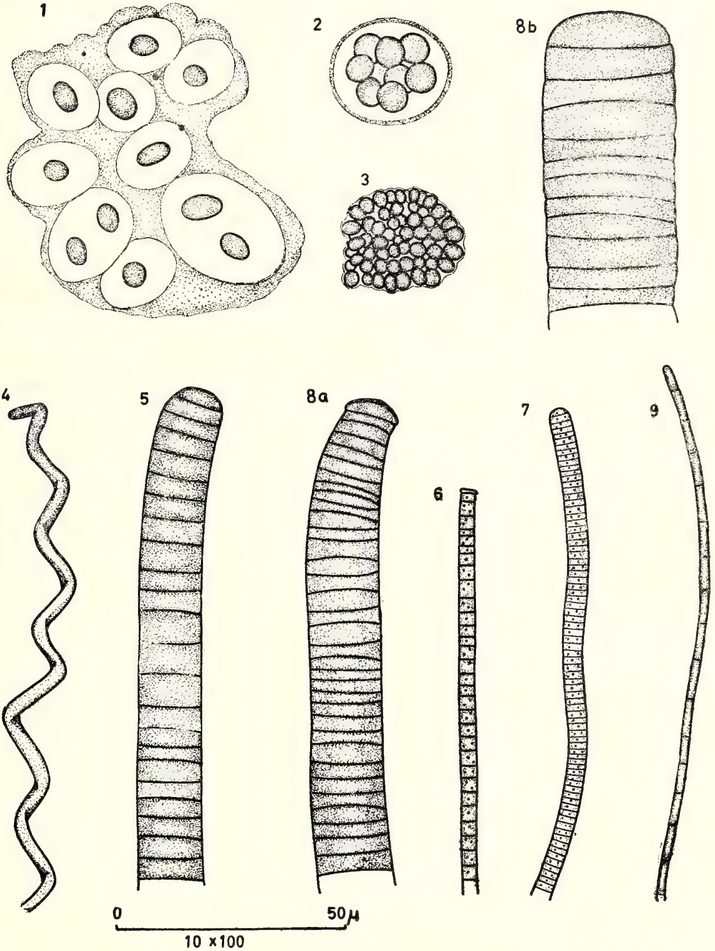
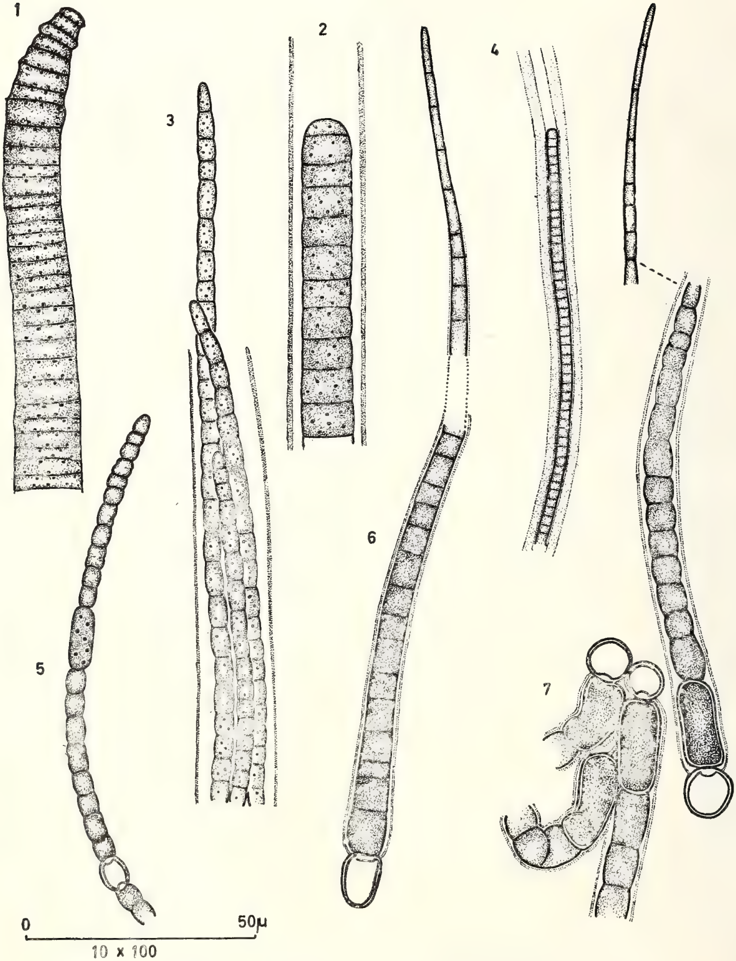
[1] Accepted May 1978.

[2] Central Silk Board, Srirampur, Mysore-8, India.

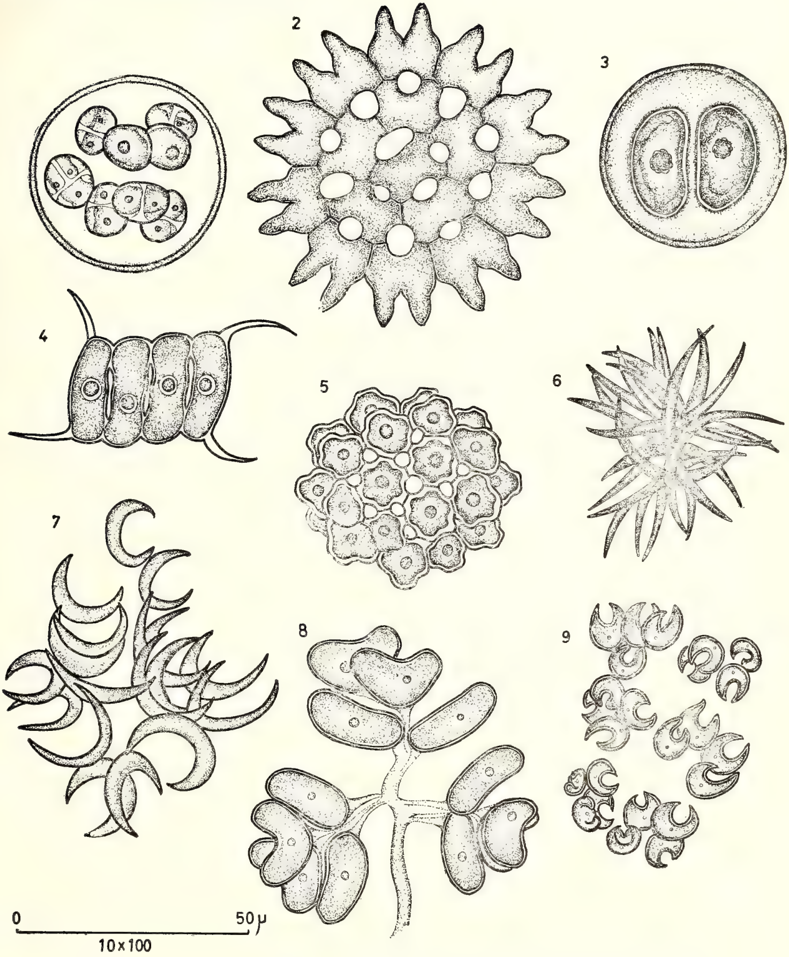
[3] Department of Botany, Karnatak University, Darwar-580 003, India.



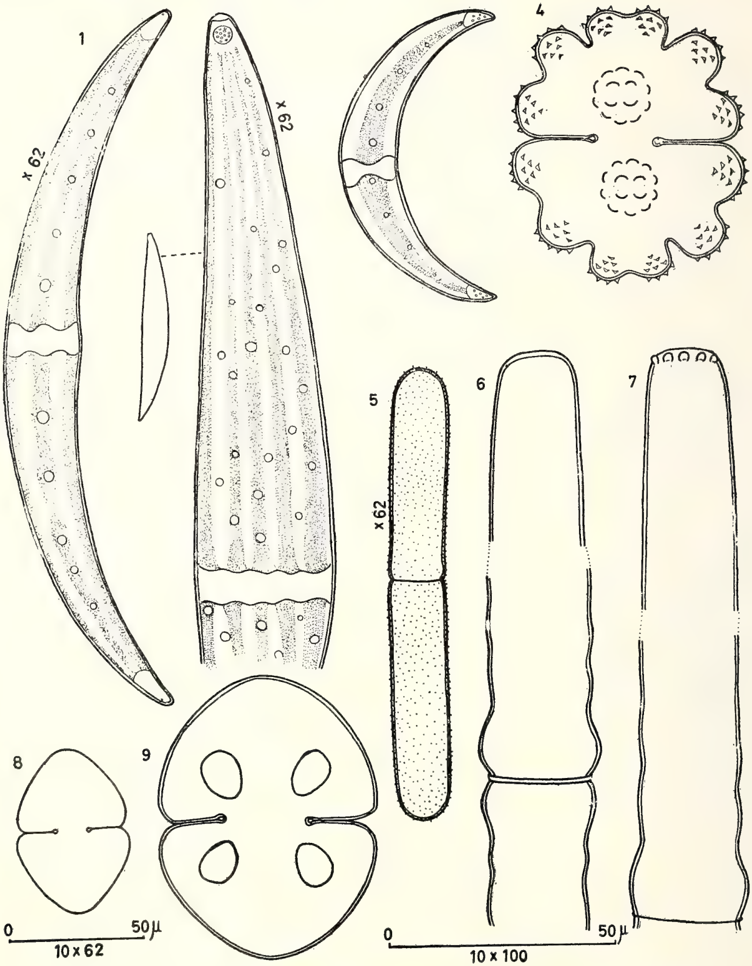
Figs. 1-9: 1. *Gloeothece membranacea* (Rabenb.) Bornet; 2. *Aphanocapsa banaresensis* Bharadwaja; 3. *Myxosarcina burmensis* Skuja; 4. *Spirulina laxissima* West, G.S.; 5. *Oscillatoria curviceps* Ag. ex Gomont; 6. *Oscillatoria irrigua* (Kutz.) Gomont; 7. *Oscillatoria obscura* Bruhl et Biswas; 8a, b. *Oscillatoria princeps* Vaucher ex Gomont; 9. *Oscillatoria subtilissima* Kütz.



Figs. 1-7: 1. *Phormidium uncinatum* (Ag.) Gomont; 2. *Lyngbya hieronymusii* Lemn.; 3. *Microcoleus subtorulosus* (Breb.) Gomont; 4. *Phormidium mucosum* Gardner; 5. *Anabaena laxa* (Rabenh.); 6. *Calothrix weberi* Schmidle; 7. *Calothrix bharadwajae* De Toni.



Figs. 1-9. 1. *Oocystis borgei* Snow; 2. *Pediastrum duplex* var. *reticulatum* Lagergheim; 3. *Nephrocytium obesum* W. et G. S. West; 4. *Scenedesmus perforatus* Lemmermann; 5. *Coelastrum cambricum* var. *intermedium* (Bohlin) G. S. West.; 6. *Ankistrodesmus fulcatus* var. *radiatus* (Chodat) Lemmermann; 7. *Selenastrum gracile* Reinsch; 8. *Dimorphococcus lunatus* A. Braun; 9. *Kirchneriella lunaris* (Kirchner) Moebius.



Figs. 1-9: 1. *Closterium leibleinii* Kützing; 2. *Closterium lunula* (Muller) Nitzsch.; 3. *Closterium venus* (Kütz.) Brébisson; 4. *Euastrum spinulosum* Delp.; 5. *Penium margaritaceum* (Ehrenb.) Bréb.; 6. *Pleurotaenium trabecula* (Ehrenbg.) Nag.; 7. *Pleurotaenium ehrenbergii* (Bréb.) De Bary; 8. *Cosmarium granatum* Bréb.; 9. *Cosmarium lundellii* var. *circulare* (Reinsch) Krieg.

1.5 to 2.0 μ broad, 3-4 times as long as broad, slightly broader than type.

Phormidium mucosum Gardner (Pl. II, fig. 4) Desikachary P. 265, Pl. 43, figs. 6, 7. Sheath mucilaginous, colourless, 7.5 to 8.0 μ broad. Trichomes bluegreen, cells nongranulated, more or less as long as broad, 2.0 to 3.0 μ broad.

P. uncinatum (Ag.) Gomont (Pl. II, fig. 1) Desikachary p. 276, Pl. 43, figs. 1, 2. Cells yellowish bluegreen, 6 to 15 μ broad cross walls granulated, trichomes attenuated at the apices. End cell round or flattened conical capitate. Cells $\frac{1}{4}$ to $\frac{1}{2}$ as long as broad, larger than the type.

Lyngbya hieronymusii Lemn. (Pl. II, fig. 2). Desikachary p. 297; Pl. 48, fig. 4. Filaments 15 to 18 μ broad, sheath firm, yellowish to colourless. Cells bluegreen granulated, sometimes at the cross walls, 11 to 12.5 μ broad, $\frac{1}{2}$ to as long as broad, longer than the type.

Microcoleus subtorulosus (Breb.) Gomont (Pl. II, fig. 3) Desikachary p. 345, Pl. 56, figs. 8, 9. Many trichomes enclosed in a colourless to brownish gelatinous sheath. Cells granulated, bluegreen, 2.5 to 3.5 μ broad, 3.5 to 7.0 μ long, smaller than the type.

Anabaena laxa (Rabenh.) (Pl. II, fig. 5.) Desikachary p. 413. Trichome 3.0 to 4.0 μ broad, straight to slightly curved. Cells mostly barrel shaped with one or two granules, 4.5 to 5.5 μ broad, apical cell rounded little attenuated. Heterocyst spherical 5.0 to 6.0 μ broad and upto 7.0 μ long. Spore away from the heterocyst, 5.0 to 6.5 broad and upto 15 μ long.

Calothrix bharadwajae De Toni, J. (Pl. II, fig. 7). Desikachary p. 526, Pl. 112, fig. 3. Filaments grouped together, sheath distinct, hyaline. Trichomes constricted at the cross walls, tapering into a long hair. Cells barrel shaped 5.0 to 6.0 μ broad, upto 9.0 μ long. Heterocysts spherical, upto 8.5 μ broad. Spores cylindrical 8.0 to 9.0 μ broad and upto 22.0 μ long.

C. weberi Schmidle (P. II. fig. 6). Desikachary p. 540. Filaments unbranched, upto 9.0 μ broad, ending into a long hair. Sheath hyaline, close to the trichome. Cells half to 2-3 times as long as broad, not constricted at the cross walls. Heterocysts spherical to slightly conical, 7.0 to 8.0 μ broad, upto 12.0 μ long.

CHLOROPHYCEAE

Pediastrum duplex var. **reticulatum** Lagergheim (Pl. III, fig. 2.). Philipose 124, fig. 43 g. Cells 10 to 18.0 μ in diameter, Colonies 16 to 32 celled, 70 to 90 μ in diameter, larger than the type.

Oocystis borgei Snow (Pl. III, fig. 1) Philipose p. 183, fig. 93. Cells 7 to 8 μ broad and 8 to 10.0 μ long. Colonies 4-8 celled 35 to 40 μ in diameter. Cells smaller than type.

Nephrocytium obesum W. et G. S. West (Pl. III, fig. 3.) Philipose 191, fig. 106. Cells 10 to 11 μ broad, 18 to 20 μ long. Colonies 30 to 35 μ in diameter. Much smaller than the type.

Dimorphococcus lunatus A. Braun (Pl. III, fig. 8). Philipose p. 205, fig. 115. Cells 5 to 10 μ broad, 15 to 20 μ long. Colonies upto 95 μ in diameter.

Ankistrodesmus falcatus var. **radiatus** (Chodat) Lemmermann (Pl. III, fig. 6.) Philipose p. 213, fig. 121 d. Cells 2.0 to 2.5 μ broad, 25 to 40 μ long, shorter than the type.

Selenastrum gracile Reinsch (Pl. III, fig. 7) Philipose 219, fig. 128. Cells 2 to 3.5 μ broad, 9 to 17 μ long, smaller than the type.

Kirchneriella lunaris (Kirchner) Moebius (Pl. III, fig. 9) Philipose p. 222, fig. 131. Cells 3 to 6.5 μ broad, 6 to 11 μ in diameter. Colonies upto 100 μ in diameter. Cells little smaller than the type.

Coelastrum cambricum Archer (Pl. III, fig. 5). Philipose p. 230, fig. 138. Cells 7 to 10 μ in diameter and colonies upto 45 μ in diameter.

Scenedesmus perforatus Lemmermann (Pl. III, fig. 4). Philipose p. 280, fig. 186 a, b, g. Cells 6 to 8 μ broad, 20 to 22 μ long. Perforations 1 to 1.5 μ broad.

Closterium leibleinii Kutzing (Pl. IV, fig. 1). Marie p. 65, Pl. 4, figs. 12, 13. Length 200 to 220 μ, breadth 20 to 25 μ in the middle, 4 to 5 μ at the pole. Larger than the type.

Cl. lunula (Mull.) Nitzsch. (Pl. IV, fig. 2) Marie. p. 70 Pl. 6, figs. 2-5. Length 370 to 410 μ, breadth 42 to 48 μ in the middle, 9 to 10.5 μ at the pole. Smaller than the type.

Cl. venus Kutzing (Pl. IV, fig. 3) Marie p. 70, Pl. 4, figs. 14-16. Length 50 to 55 μ, breadth 10 to 12 μ in the middle, 2 to 2.5 μ at the pole.

Penium margaritaceum (Ehrenb.) Breb. (Pl. IV, fig. 5) Marie. p. 87, Pl. 8, fig. 14. Length 150 to 162 μ, breadth 20 to 23 μ.

Pleurotaenium ehrenbergii (Breb.) De Bary. (Pl. IV, fig. 7) Marie p. 97, Pl. 11, figs. 5, 6. Length 200 to 220 μ, breadth 24 to 27 μ in the middle, 15 to 17 μ at the pole.

P. trabecula (Ehrbg.) Nag. (Pl. IV, fig. 6) Scott and Prescott p. 18, Pl. 3, fig. 4. Length 390 to 430 μ, breadth 21.0 to 23.0 μ in the middle, 18.0 to 19.0 μ at the pole, isthmus 15.0 to 17.0 μ. Smaller than the type.

Euastrum spinulosum Delp. (Pl. IV, Fig. 4) Scott and Prescott p. 40, Pl. 10, fig. 4. Length 48.0 to 51.0 μ, breadth 40.0 to 42.0 μ, isthmus 10.0 to 11.0 μ. Smaller than the type.

Micrasterias foliacea Bail. (Pl. V, fig. 2.) Scott and Prescott p. 48, Pl. 20, fig. 4, Length 55.0 to 62.0 μ breadth 62.0 to 68.0 μ, isthmus 10.0 to 11.5 μ. Little smaller than type.

M. pinnatifida (Kutz.) Ralfs (Pl. V, fig. 1) Scott and Prescott p. 51, pl. 14, figs. 17, 18. Length 45.0 to 49.0 μ, breadth 54.0 to 56.0 μ, and polar lobe 30.0 to 34.0 μ, isthmus 9.5 to 10.0 μ.

Cosmarium contractum Kirchn. (Pl. V, fig. 8) Scott and Prescott, p. 56, pl. 27, fig. 4. Length 24.5 to 27.0 μ, breadth 17.5 to 18.5 μ isthmus 4.5 to 5.0 μ. Smaller than the type.

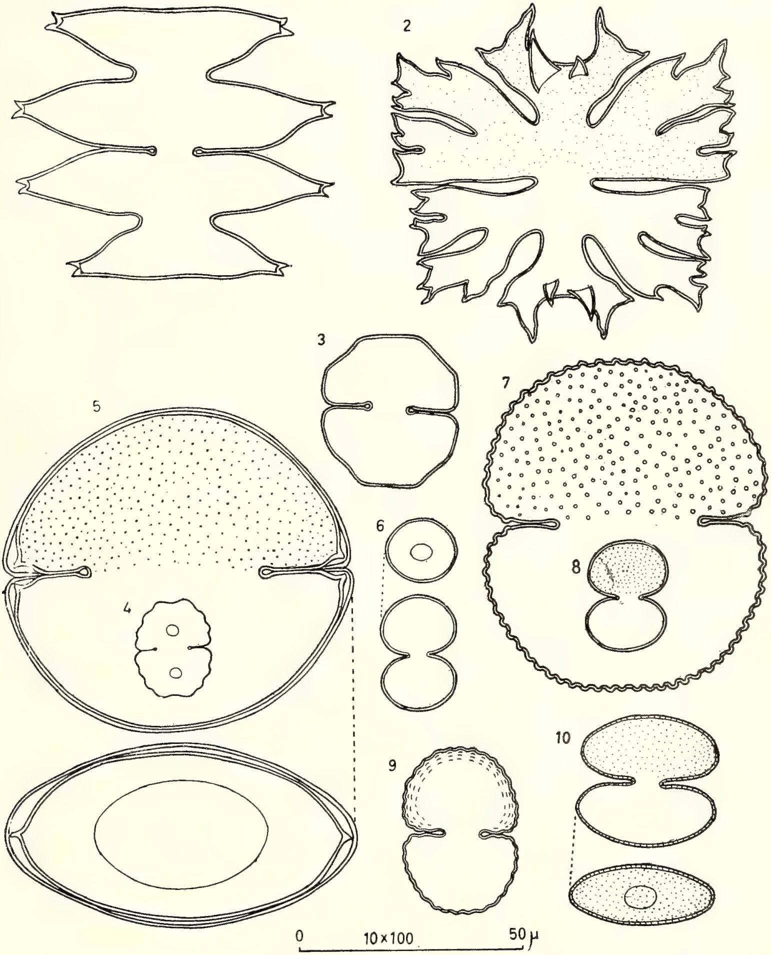
C. dentiferum var. **alpinum** Messik. (Pl. V. fig. 7). Messikommer, p. 156, pl. II, fig. 1., Length 54.0 to 58.0 μ, breadth 48.0 to 51.0 μ, isthmus 23.0 to 24.5 μ.

C. dubium Borge (Pl. V, fig. 4) Scott and Prescott, p. 58, pl. 32, fig. 3. Length 16.0 to 17.5 μ, breadth 12.0 to 13.5 μ, isthmus 4.5 to 5.0 μ.

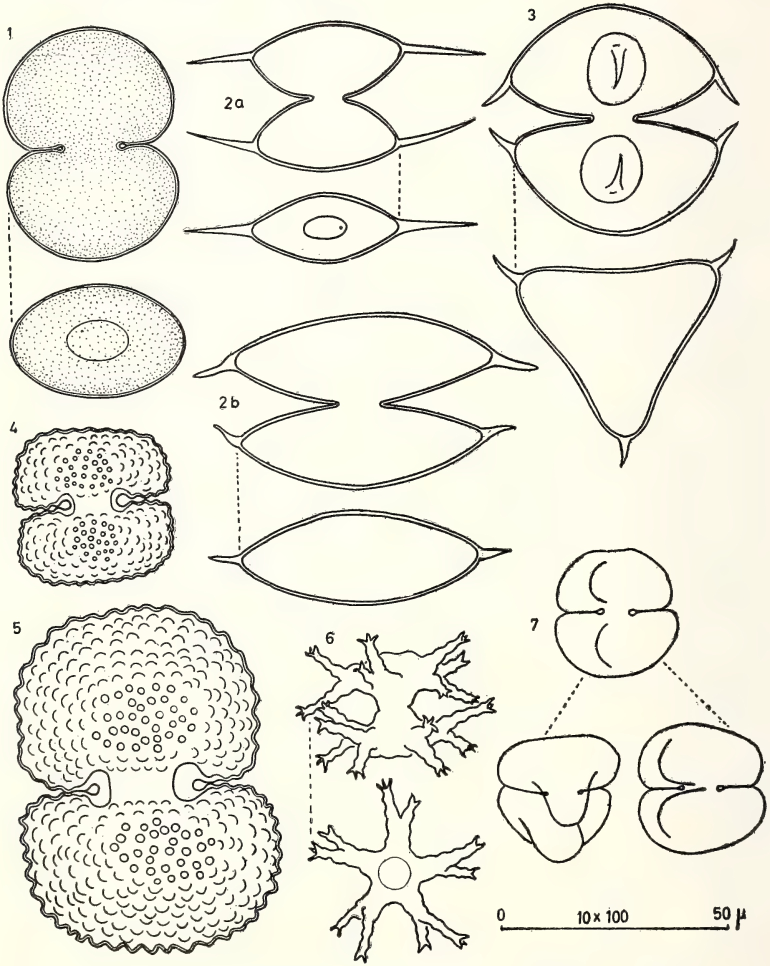
C. granatum Brebisson (Pl. IV, fig. 8) Prescott 1966, p. 15, pl. III, fig. 30. Length 29.0 to 30.5 μ, breadth 19.0 to 20.5 μ, isthmus 4.5 to 5.5 μ.

C. lundellii var. **circulare** (Reinsch) Krieg. (Pl. IV, fig. 9) Scott and Prescott p. 60, Pl. 25, fig. 7. Length 50.0 to 54.0 μ., breadth 41.0 to 43.0 μ, isthmus 14.5 to 16.0 μ.

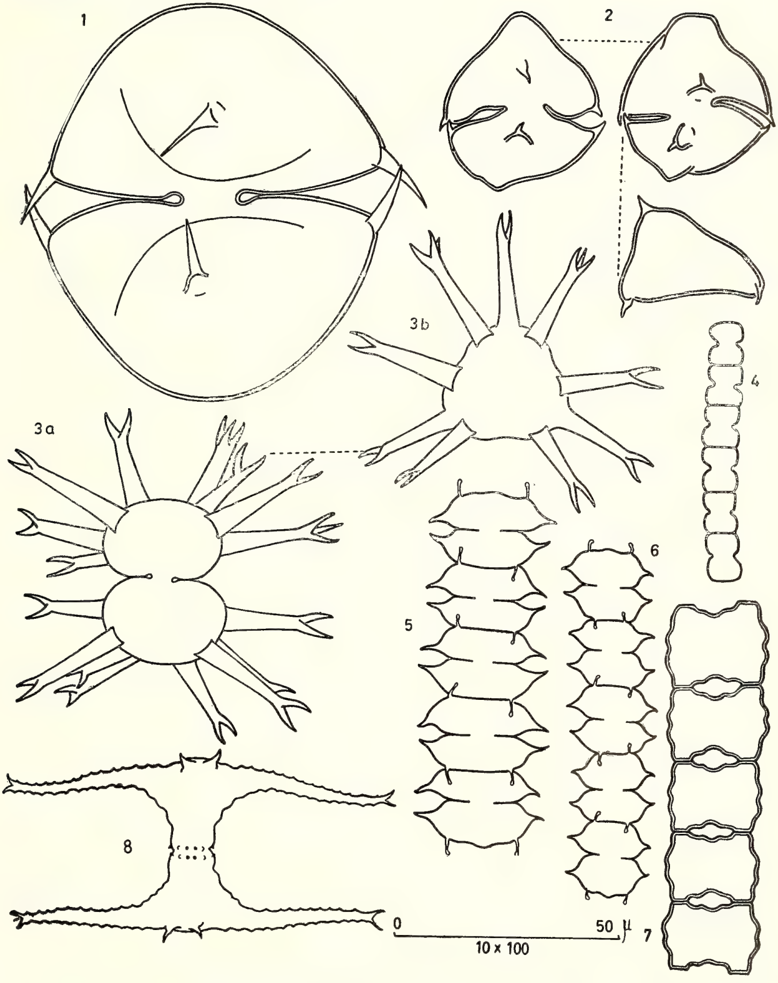
Cosmarium sp. (Pl. VI, fig. 5).



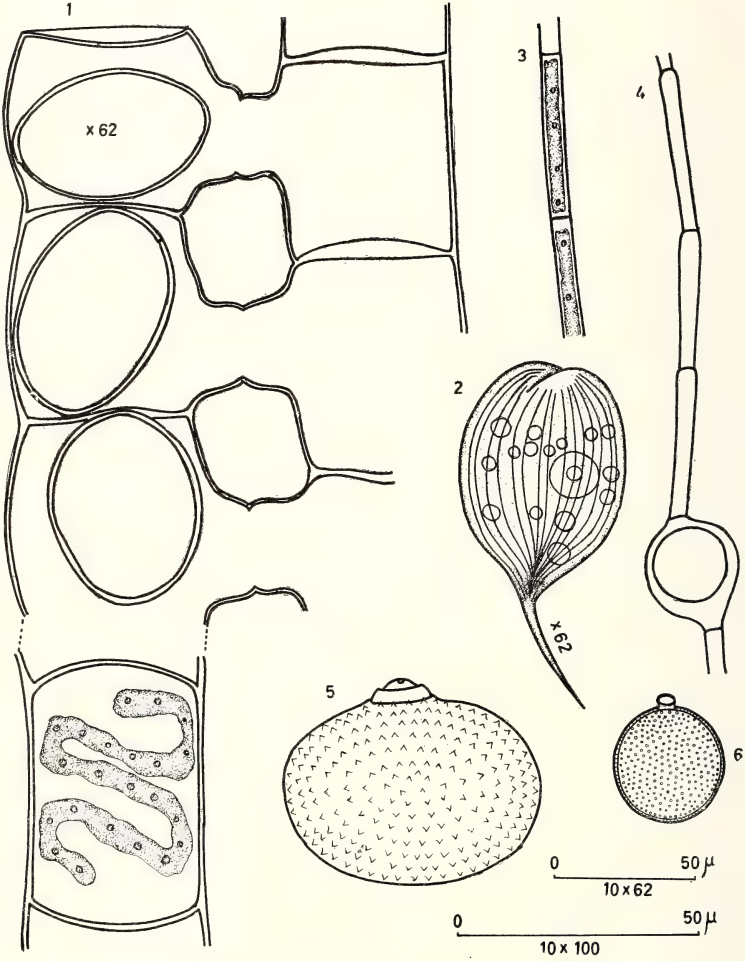
Figs. 1-10: 1. *Micrasterias pinnatifida* (Kütz.) Ralfs.; 2. *Micrasterias foliacea* Bail.; 3. *Cosmarium retusiforme* (Wille) Gutw.; 4. *Cosmarium dubium* Borge; 5. *Cosmarium obsoletum* var. *sitvense* Gutw.; 6. *Cosmarium moniliforme* (Turp.) Ralfs.; 7. *Cosmarium dentiferum* var. *alpinum* Messik.; 8. *Cosmarium contractum* Kirchn.; 9. *Cosmarium speciosum* var. *simplex* Nordst.; 10. *Cosmarium perfissum* G. S. West.



Figs. 1-7: 1. *Cosmarium subcucumis* Schmidle; 2a, b. *Arthrodesmus convergens* Ehrbg.; 3. *Staurastrum dickie* Ralfs.; 4. *Cosmarium scabrum* Turn.; 5. *Cosmarium* sp.; 6. *Staurastrum sexangulare* var. *subglabrum* West and West; 7. *Staurastrum orbiculare* var. *depressum* Roy and Biss.



Figs. 1-8: 1. *Staurastrum dickie* Ralfs.; 2. *Staurastrum dickie* Ralfs.; 3. *Staurastrum tohopekaligense* var. *insigne* West and West; 4. *Spondylosium planum* (Wolle) West et G. S. West; 5. *Onychonema laeve* var. *latum* West and West; 6. *Onychonema laeve* var. *micracanthum* Nordst.; 7. *Desmidium aptagonum* Brebisson; 8. *Staurastrum leptocladum* Nordst.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Figs. 1-6: 1. *Spirogyra borgeana* Transeau; 2. *Phacus longicauda* (Ehrenb.) Dujardin.; 3. *Mougeotia* sp.; 4. *Oeodogonium* sp.; 5. *Trachelomonas mamillosa* Prescott; 6. *Trachelomonas acanthostoma* (Stokes) Deflandre.

C. moniliforme (Turp.) Ralfs. (Pl. V, fig. 6) Marie. P. 172, pl. 23, fig. 12. Length 19.0 to 22.0 μ, breadth 13.0 to 14.5 μ. isthmus 3.0 to 3.5 μ.

C. obsoletum var. **sitvense** Gutw. (Pl. V, fig. 5) Scott and Prescott, p. 63, pl. 25, fig. 11. Length 55.0 to 61.0 μ, breadth 59.0 to 66.0 μ, isthmus 15.0 to 16.5 μ.

C. perfissum G. S. West (Pl. V, fig. 10) Scott and Prescott p. 65, Pl. 26, fig. 8. Length 20.0 to 23.5 μ, breadth 21.0 to 24.0 μ, isthmus 4.5 to 5.0 μ. Slightly narrower than the type.

C. retusiforme (Wille) Gutw. (Pl. V, fig. 3). Scott and Prescott P. 68, Pl. 32, fig. 15. Length 32.0 to 34.5 μ, breadth 30.0 to 31.5 μ, isthmus 8.0 to 8.5 μ. Bigger than the type.

C. speciosum var. **simplex** Nordst. (Pl. V, fig. 9) Marie, p. 204, pl. 30, fig. 8. Length 30.0 to 32.0 μ, breadth 20.0 to 22.5 μ, isthmus, 6.0 to 6.5 μ. Smaller than the type.

C. subcucumis Schmidle (Pl. VI, fig. 1) Marie P. 161, Pl. 25, fig. 3. Length 41.0 to 45.0 μ, breadth 28.0 to 33.0 μ, isthmus 7.0 to 8.5 μ. Smaller than the type.

C. scabrum Turn. (Pl. VI, fig. 4) Scott and Prescott, p. 68, Pl. 29, fig. 3. Length 30.0 to 32.5 μ, breadth 30.0 to 32.0 μ, isthmus 7.0 to 7.5 μ. But much differs and is smaller than the type.

Arthrodesmus convergens Ehrbg. (Pl. VI, figs. 2a, b). Scott and Prescott. P. 74, Pl. 34, figs. 7-10. Length 27.0 to 34.0 μ, breadth 27.0 to 44.0 μ, isthmus 6.5 to 8.0 μ, arm length 5.0 to 15.5 μ.

Staurastrum dickie Ralfs. (Pl. VI, fig. 3, Pl. VII, fig. 1) Marie, P. 275, Pl. 44, fig. 10. Length 70.0 to 85.5 μ, breadth 60.0 to 76.0 μ, isthmus 9.5 to 14.5 μ, arm length 10.0 to 11.5 μ. Much larger than the type.

St. dickie Ralfs. (Pl. VII, fig. 2) Marie, p. 275, pl. 44, fig. 10. Length 32.0 to 33.5 μ, breadth 29.0 to 32.0 μ, isthmus 6.5 to 8.0 μ, arm 4.0 to 4.5 μ. This form differs from the type in having conical to dome shaped semicells. The basal angles of the semicells are more concave than the type. In the top view, the margins are straight or slightly concave. The spines appear inside the semicell.

It is possible that this may be a new variety of the type.

St. orbiculare var. **depressum** Roy and Biss. (Pl. VI. fig. 7) Scott and Prescott p. 100, pl. 52, fig. 12. Length 23.0 to 25.5 μ, breadth 22.0 to 24.5 μ, isthmus 4.0 to 4.5 μ.

St. leptocladum Nordst. (Pl. VII, fig. 8). Marie p. 299, pl. 53, fig. 4. Length 36.0 to 38.5 μ, breadth in the middle 10.0 to 10.5 μ, breadth total including the arms 85.0 to 88.0 μ isthmus 9.0 to 9.5 μ.

St. sexangulare var. **subglabrum** West and West (Pl. VI, fig. 6). Scott and Prescott, p. 107, pl. 46, figs. 1 and 2. Length 35.0 to 37.5 μ, breadth total, including the arms 60.0 to 64.0 μ, breadth in the middle 12.0 to 13.5 μ isthmus 10.0 to 11.0 μ.

St. tohopekaligense var. **insigne** West and West (Pl. VII, fig. 3) Scott and Prescott, p. 113, pl. 47, figs. 12-15. Length 33.0 to 34.5 μ, breadth 26.0 to 27.5 μ, isthmus 5.0 to 5.5 μ, arm length about 24.0 μ.

Spondylosium planum (Wolle) West et G. S. West (Pl. VII, fig. 4.) Marie p. 353, pl. 61, figs. 17, 18. Length 9.00 to 12.5 μ, breadth 6.5 to 7.0 μ, isthmus 5.0 μ. Little narrower than the type.

Onychonema laeve var. **latum** West and West (Pl. VII, fig. 5) Scott and Prescott, p. 121, pl. 60, fig. 13. Length 14.0 to 15.5 μ, breadth 17.0 to 19.0 μ, isthmus 3.0 μ arm 3.5 to 4.0 μ.

O. laeve var. **micracanthum** Nordst. (Pl. VII, fig. 6). Marie p. 345, pl. 61, figs. 4-6. Length 13.0 to 14.5 μ, breadth 11.0 to 12.0 μ, isthmus 6.0 μ, arm 2.5 to 3.0 μ.

Desmidium aptagonum Brebisson (Pl. VII, fig. 7). Prescott 1966, p. 42, pl. 11, fig. 14. Length 15.0 to 17.0 μ breadth 22.0 to 24.5 μ Smaller than the type.

Spirogyra borgeana Transeau (Pl. VIII, fig. 1). Prescott 1951, p. 311, pl. 77. figs. 7, 8. Cells 55.0 to 61.0 μ, in diameter, 65.0 to 77.0 μ long. Chloroplast solitary making 2-4 turns. Zygospores ellipsoid, smooth walled 37.0 to 43.0 μ in diameter and 55.0 to 62.0 μ long.

Phacus longicauda (Ehrenh.) Dujardin (Pl. VIII, fig. 2). Prescott 1951. p. 400, pl. 87, fig. 1. Cells tapering gradually in to a long caudus at the posterior end, 55.0 to 61.0 μ in diameter 69.0 to 74.0 μ long. caudus 35.0 to 40.0 μ long. Shorter than the type.

Trachelomonas acanthostoma (Stokes) Deflandre (Pl. VIII, fig. 6) Prescott 1951, p. 410, pl. 85, fig. 3. Test subglobose, 19.0 to 20.0 μ in diameter, 20.0 to 21.0 μ long. Collar not very low, slightly longer than the type.

T. mamillosa Prescott (Pl. VIII, fig. 5) Prescott 1951, p. 415, pl. 85, fig. 12. Test 46.0 to 49.0 μ diameter and 36.5 to 38.0 μ long.

Flagellum aperture in a mamillate swelling as in the type. But unlike the type, test is ovate, and covered throughout with prominent spines. Also it is larger than the type.

So it is possible that this might be a new variety.

Mougeotia sp. (Pl. VIII, fig. 3).

Oeodogonium sp. (Pl. VIII, fig. 4).

BACILLARIOPHYCEAE

Synedra ulna var. **aequalis** (Kütz.) Hustedt (Pl. IX, fig. 15). Hüstedt 1937, p. 199, fig. 691 a, d. Length 100.0 to 112.0 μ, breadth 6.0 to 7.5 μ. Striae 9.0 in 10.0 μ.

S. ulna var. **biceps** (Kütz.) (Pl. IX, fig. 14) Hüstedt. 1937, p. 200, fig. 691, g. Length 300.0 to 340.0 μ, breadth 6.5 to 7.0 μ. Striae 9 in 10.0 μ.

Cymbella ventricosa Kütz. (Pl. IX, fig. 2.) Hüstedt 1949, p. 116, pl. 9, figs. 8-11. Length 31.0 to 33.0 μ, breadth 9.5 to 11.0 μ, Striae 10 to 13 in 10 μ.

Cymbella mulleri Hüstedt (Pl. IX, fig. 1) Hüstedt 1949, p. 115, pl. 9, figs. 1-7. Length 89.0 to 93.5 μ, breadth 20.0 to 21.5 μ, striae 7 in 10.0 μ.

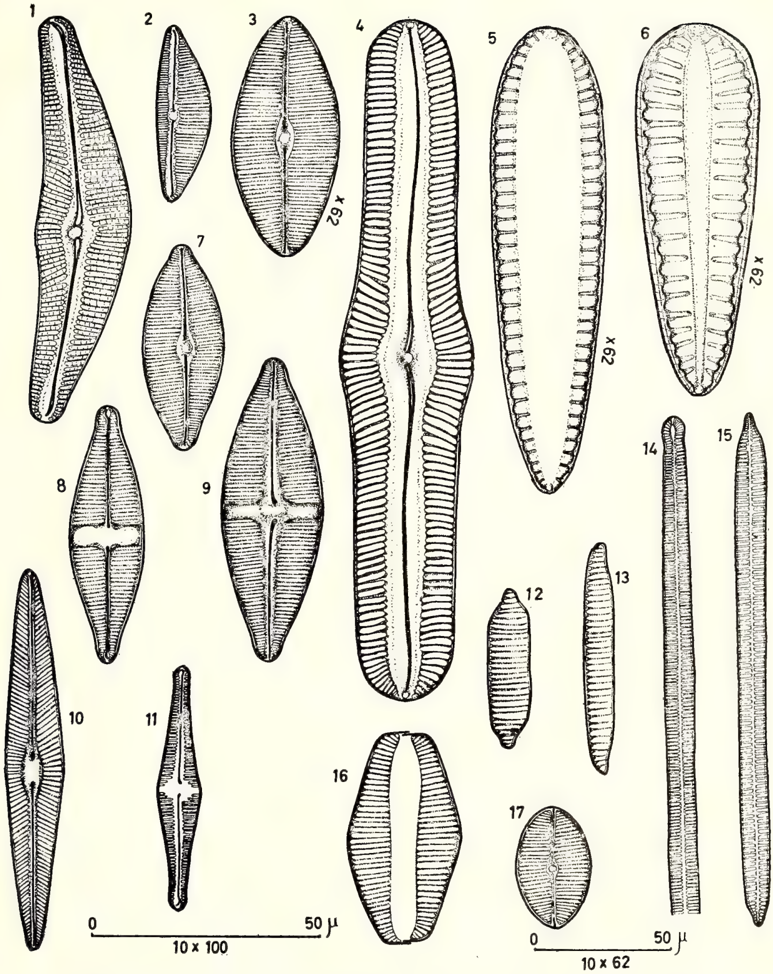
Cocconeis disculus (Schumann) Cleve (Pl. IX, fig. 17) Hüstedt 1937, p. 345, fig. 799. Length 24.0 to 26.5 μ, breadth 14 to 15.5 μ. Striae 15 to 17.0 in 10.0 μ. (Raichur).

Surirella novilis Smith (Pl. IX, fig. 5) Smith 1853, p. 32, pl. VIII, fig. 63. Length 159.0 to 166.0 μ, breadth 38.0 to 42.0 μ. Costae 3 in 10.0 μ.

S. splendida var. **minor** Meister (Pl. IX, fig. 6) Majeed 1935 p. 41, pl. VI, fig. 6. Length 116.0 to 121.0 μ, breadth 38.0 to 41.0 μ, costae 2 in 10.0 μ.

Nitzschia obsoleta (Pl. IX, fig. 13). Hüstedt 1949, p. 146, pl. 13, figs. 94-99. Length 45.0 to 49.5 μ, breadth 7.5 to 8.0 μ, Striae 10 in 10.0 μ. (Raichur).

PLATE IX



Figs. 1-17: 1. *Cymbella mulleri* Hustedt; 2. *Cymbella ventricosa* Kütz.; 3. *Navicula crucicula* (W. Sm.) Donkin; 4. *Pinnularia major* W. Sm.; 5. *Surirella novilis* Smith; 6. *Surirella splendida* var. *minor* Meister.; 7. *Navicula bacilloides* Hüstedt; 8. *Stauroneis wislouchii* Poretzky et Anisinova.; 9. *Stauroneis elata* Hüstedt; 10. *Acanthes exilis* Kützing; 11. *Caloneis clevei* (Lagerstedt) Cleve; 12. *Nitzschia umblicata* Hüstedt; 13. *Nitzschia obsoleta* Hüstedt; 14. *Synedra ulna* var. *biceps* (Kütz.); 15. *Synedra ulna* var. *aequalis* (Kütz.) Hustedt; 16. *Rhopalodia gibberula* (Ehr.) O. Mull.; 17. *Cocconeis disculus* (Schumann) Cleve.

Nitzschia umblicata Hüstedt (Pl. IX, fig. 12) Hüstedt. 1949, p. 129, pl. 11, fig. 65. Length 33.0 to 36.5 μ, breadth 10.0 to 10.5 μ, Striae 10 in 10.0 μ. Slightly broader than the type.

Navicula bacilloides Hüstedt (Pl. IX, fig. 7) Hüstedt 1961, p. 117, fig. 1250. Length 41.0 to 44.5 μ breadth 15.0 to 16.4 μ, striae 13 in 10.0 μ. Larger than the type (Raichur).

N. crucicula (W. Sm.) Donkin (Pl. IX, fig. 3) Hüstedt 1962, p. 318, fig. 1436, a-c. Length 81.5 to 84.0 μ, breadth 27.0 to 29.5 μ, striae 16.0 to 17.0 in 10.0 μ (Raichur).

Pinnularia major W. Sm. (Pl. IX, fig. 4.) Smith 1853, p. 54, fig. 162, pl. XVIII, fig. 162. Length 130.0 to 146.0 μ, breadth 20.0 to 21.5 μ at the middle, 14.0 to 15.0 μ at the pole, costae 9-10 in 10.0 μ (Davanagere and Raichur).

Stauroneis elata Hüstedt (Pl. IX, fig. 9.) Hüstedt 1959, p. 794, fig. 1139. Length 58.0 to 61.5 μ, breadth 16.5 to 18.0 μ, striae 20.0 in 10.0 μ (Raichur).

S. wislouchii Poretzky et Anisinova (Pl. IX, fig. 8) Hüstedt 1959, p. 792, fig. 1137. Length 51.0 to 54.5 μ, breadth 15.0 to 16.5 μ, striae 15-18 in 10.0 μ, dissolving (Raichur).

Caloneis clevei (Lagerstedt) Cleve (Pl. IX, fig. 11) Hüstedt 1949, p. 98, pl. 11, fig. 33, Length 48.0 to 51.0 μ, breadth 8.5 to 9.0 μ, striae 12 in 10.0 μ.

Acanthes exilis Kützing (Pl. IX, fig. 10) Hüstedt 1937, p. 378, fig. 822. Length 60.0 to 66.0 μ breadth 9.0 to 10.5 μ, striae 15.0 to 17 in 10.0 μ.

Rhopalodia gibberula (Ehr.) O. Mull. (Pl. IX, fig. 16) Majeed 1935 p. 36, pl. V, fig. 15. Length 41.0 to 45.5 μ, breadth 23.0 to 24.5 μ, costae 9 to 10 in 10.0 μ, broader than the type.

16 Cyanophyceae, 48 Chorophyceae (including 33 desmids) from Davanagere and 17 Bacillariophyceae from both Davanagere and Raichur have been described.

ACKNOWLEDGEMENTS

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REFERENCES

BHARATI, S. G. AND BONGALE, U. D. (1975): Systematic account of fresh water algae of Raichur, Karnatak State, India. *Karnatak Uni. J. Sci., 20*: 130-141.

DESIKACHARY, T. V. (1959): Cyanophyta. *ICAR. Publ.* New Delhi.

HUSTEDT, F. (1937, 1949, 1959, 1961, 1962): Dr. L. Rabenhorsts Kryptogamen Flora Akademisch Vertagsgesellschaft M. b. H. Leipzig Publ.

MARIE—IRENE, F. (1938): Flora Desmidiale de la Region Montreal, *Laprairie, Canada* Publ.

MAJEED, M. A. (1935): The Fresh Water Algae of The Punjab Part I. Bacillariophyta (Diatomeae). *The Uni. of Punjab,* Lahore. Publ.

MESSIKOMMER, P. E. (1942): Beitrag zur Kenntnis der Algen flora und Algenvegetation des Hochgebirges um Davos. *Verlag Hans Haber Bern Publ.*

PHILIPOSE, M. T. (1967): Chlorococcales. *ICAR* New Delhi Publ.

PRESCOTT, G. W. (1951): Algae of the Western Great Lakes Area. Cranbrook Inst. of Sci. Publ.

———— (1966): Algae of the Panama Canal and its Tributaries-II, Conjugales. *Phykos 5,* (Iyengar Memorial Volume): 1-49.

SCOTT, A. M. AND PRESCOTT, G. W. (1961): Indonesian Desmids. *Hydrobiologia, 17* (1 and 2).

SMITH, W. (1853): A synopsis of the British Diatomaceae. Jon. vàn Vorst, Paternoster Row. Publ. Vol. 1.

BIRD NOTES FROM BALUCHISTAN PROVINCE, PAKISTAN[1]

T. J. ROBERTS[2]

INTRODUCTION

Practically nothing has been recorded about the avifauna of this fascinating area since the second world war, when Brigadier A. F. P. Christison gave an account of the birds seen in the south-western part of the Province (1941) and subsequently described some new records for the northern part of Baluchistan (1942). In fact most of our knowledge about the breeding birds in Baluchistan is based upon earlier writers (Meinertzhagen 1914, Ticehurst 1926-27, and Williams & Williams 1929). Since the area is in the south-eastern fringe of the great Palaearctic region and is characterised by mountain steppe or cold desert, it tends to have faunal affinities with Afghanistan, and Soviet Asia rather than the rest of the Indian sub-continent. The purpose of this note is to give detailed descriptions of two places of considerable ornithological interest in order to reflect the present day status of one and to draw attention to the other which seems to have been missed by earlier ornithologists working in the region.

Sirandah lake

In Dr. Sálim Ali's HANDBOOK series (The Birds of India and Pakistan) this lake is mentioned as the only locality within the territorial limits covered by these ten volumes, where the Slenderbilled Gull (*Larus genei*) and the Caspian tern (*Hydroprogne caspia,* synonym *Sterna caspia*) (de Voous 1973) are known to breed. Sirandah is also recorded in the HANDBOOK as a regular breeding site for Gull-billed terns (*Gelochelidon nilotica*) and the Marbled Teal (*Anas angustirostris*).

When I moved to Karachi in the autumn of 1973 I was naturally keen to visit this lake and studied all available literature. I had difficulty in locating the lake until 1974, and because I could learn so little about the place I feel that my limited observations are worth recording. Perhaps some twentyfirst century ornithologist, writing about the extinct or vanishing birds of the Middle East region will find my notes of value!

General Bentham and Mr. Ludlow, two British Government officials visited Sirandah lake around the turn of the century and submitted manuscript notes to Stuart Baker, who edited the Ornithological Journal for the region in those times, "Stray Feathers". Dr. Claude B. Ticehurst, a Captain Surgeon in the Army was stationed in Karachi from 1917 to 1918 and mentions Sirandah in his comprehensive account of the Birds of Sind (*Ibis* 1922-1924) but he did not apparently go there personally. Kenneth Eates of the Indian Police, a great oologist and authority on the birds of Sind, visited Sirandah in the early 1930s. I know of no other written records about this lake and imagine that it has been very seldom visited by any competent ornithologists within the past 50 years.

Despite the huge growth of Karachi City,

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now a sprawling metropolis of 4.5 million people, the adjacent hinterland is still very sparsely populated being not only desert, but rocky and unsuitable for cultivation. Sirandah Lake lies 90 Km. west north west of Karachi in Las Bela District in the extreme south eastern corner of Baluchistan Province. Its approximate location is 66° 40′ East and 25° 30′ North. It is a good three Kilometres from the only road in the region which runs to the towns of Uthal and Bela. There are no villages anywhere nearby and even today the lake is seldom disturbed by human visitors. It lies in a shallow basin near Sonmeani Lagoon connected to the open sea 6½ km. to the west, and is surrounded to the north and west by sedimentary sandstone hills. It is cut off from the sea by a spectacular series of 50 metre high barren sand hills. The area receives absolutely no rainfall from end September till early July and the monsoon influence is erratic, hardly bringing any rain in some years. The few dry nullahs which drain to the coast are blocked off by the above mentioned high sand dunes and hence after monsoon rains a lake tends to form in the bottom of the basin. It is always highly brackish and due to fluctuating water levels there are no sedges or reeds established along its barren margins. The only vegetation consists of scattered trees of *Prosopis spicigera,* much lopped for goat browse, and in the low lying areas stunted *Tamarix troupii* bushes. The ground consists of undulating sand hills upto 2 to 3 metres in height and dotted with salt-wort bushes, both *Sueda fruticosa* and *Salsola foetida.* The area is severely hot in summer with temperatures exceeding 44°C in June.

When first visited by me in 1974, guided by some local fisherman, the lake was much shrunk in size and no one could recall any terns or gulls nesting there within recent years. Because of its remoteness, the lake always has 100 or 200 Greater flamingos (*Phoenicopterus ruber*) and a few Pelicans (both species). In winter small numbers of coot and dabbling ducks use it as a resting ground and perhaps the most interesting bird in the Common Sheld duck (*Tadorna tadorna*) which spends the winter in fair numbers on the lake. In 1977 I counted a flock of 80. In wildfowl censuses of Pakistan conducted over 5 years by Mr. F. Koning for the I.W.R.B. during the early 1970s, at the most 3 to 5 Sheld ducks were recorded per annum between all the major wetlands of Pakistan and apart from the Marbled Teal, this is Pakistan's rarest duck. In one year on June 9th I saw many Rednecked Phalaropes (*Phalaropus lobatus*). Though so close to the open sea on which they spend the winter, it seemed late for migrating waders to be tarrying on this lake at the start of their migration. During other summer visits I have got the impression that a few Curlew Sandpipers (*Calidris ferruginea*), Little Stints *(Calidris minuta)* and Dunlin (*Calidris alpina*) spend the entire summer around the lake shores. In February 1978 the lake was very shallow and had shrunk to a mere 30 hectares and I did not bother to visit it again. Indeed I believed that no terns or gulls could have nested there for many decades. I have never seen any Marbled Teal there. Stuart Baker, who lived and worked in North East India, referred to Caspian Terns nesting in bushes on an island in the lake. (FAUNA OF BRITISH INDIA Vol. VI). There are no permanent vegetated islands in the lake and his observations about nests on bushes were so untypical of *Sterna* species as to imply that this was some second-hand account emanating rather from the reports of uneducated egg collectors. Great was my excitement, therefore when in May, 1979 a fisherman friend from nearby Sonmeani came to report that 'hundreds of Terns', were nesting at Sirandah. The Mekrani language for Tern is "Khora" and for Gull is "Kinari". May 24th was the first Friday when an opportunity allowed the lake to be visited. The 3 Km walk over soft sand dunes, coupled with the terrific heat made prolonged observations difficult. Added to this we discovered a temporary settlement of fishermen on the extreme southern corner of the lake. These men, occupying two palm thatched huts, insisted on accompanying us and this added to the disturbance of the nesting birds. The monsoon rains of 1978 were unprecedently heavy in Las Bela district. Road bridges were swept away and many heads of livestock as well as people were drowned by flash floods pouring down normally dry sandy nullahs. The lake was transformed from my memories of February 1978. It now stretched for perhaps 6 kilometres in a north south axis with numerous inlets and lagoons between the sand hills and several islands. The nearest of these, located 1½ kilometres from the fishing camp, revealed great activity with wheeling flocks of Slender-billed Gulls. By wading thigh deep, we could reach the island which was a long narrow sand bar, some 200 metres in length and practically devoid of vegetation. In the middle and highest part of the island was a colony of some 60 pairs of Slenderbilled Gulls.

Most nests contained two downy young, and only about ten still contained eggs, all with clutches of two. No nests had three eggs, or appeared to have 3 young. I thought this was due to heavy egg predation by the fishermen as there was a basket full of gulls eggs in one of their huts collected the week before. However Meinertzhagen records that 2 is the normal clutch size in Sind (BIRDS OF ARABIA 1954). The nests, about 11 cm in diameter and as close as 0.75 metres apart, were quite substantial saucers of blackened bits of saltwort with stalks and stems and a surprising number of both gull and flamingo feathers in the cup lining. The eggs are pale greenish to almost white in ground colour and much paler than any other gulls eggs I know of. I believe that the parent birds must have to wet their eggs regularly and incubate them also throughout the day, simply to prevent the developing chicks from overheating and being killed by the intense heat. The chicks had black feet and bills (unlike their parents), their body covered with almost white down with small black spots forming bars along the crown and wings. They were most attractive and when picked up did not regurgitate their food as Herring gull chicks *(Larus argentatus)* in Britain commonly do. Possibly this was because they had not been fed by their parents since early morning, these gulls confining their foraging to morning and evening.

On the far side of the island, nearer to the waters edge were six Caspian terns nests. These were hollows in the sand, devoid of any lining or decoration, and located 10 to 15 metres from each other. Unlike the wheeling flock of Slenderbills, the Caspian terns repeatedly dived over our head and uttered harsh alarm cries. All contained two eggs of a pale greyish stone colour with comparatively small spots of olive brown and violet grey under markings. In body size the Caspian tern is not much bigger than *L. genei* but its eggs are quite remarkably bigger and more pointed at the narrow end. Between the Caspian Terns and the Slenderbill gulls nests, were two disjunct colonies of Gullbilled Terns (*Gelochelidon*) comprising about 17 nests in all—each with two eggs only and no chicks hatched. These nests were noticeably decorated with bits of leaves and stems and shells and the eggs were much smaller than those of the Caspian terns or Slenderbilled Gulls. I estimated in the gull colony, that nest building must have commenced from early April and egg laying from mid April. Ticehurst (Birds of Sind, *op. cit.*), records their nesting in June and this is repeated in other books. The terns had obviously started nesting three or four weeks after the gulls and towards the middle of May.

Conversation with the fisherman was disturbing. Not only did they regularly collect gulls and terns eggs to eat, but also one of their number was skilled at snaring flamingoes. Equipped with a long shaft propellor, out board motor and a rickety boat, they had been at the lake since October 1978 and during the winter had killed two adult flamingoes, bearing rings on their legs. I have not seen nor been able to recover these, but my fisherman friend said he saw them and they were Iranian rings. Rather surprising as I would otherwise have assumed them to be Bombay Natural History Society rings from the Rann of Kutch.

I arranged with another intelligent and reliable fisherman who had accompanied me on May 24th that he should visit Sirandah Lake a second time. This was possible on June 12th and he brought back the following report. Due to evaporation the lake had become increasingly brackish and many fish were dying off. The fishermen had abandoned their temporary camp at Sirandah. Worse still, the nearby island was also deserted and hardly any Slenderbilled Gulls could even be observed. On this island addled eggs remained in a few nests but no chicks. All the terns nests were also deserted. The colony had deserted either as a result of excessive human egg predation or more probably because of difficulty in feeding the chicks. Gulls must dip for surface swimming fry and monsoon conditions would make it difficult for them to catch fish from the open sea $6\frac{1}{2}$ kilometres distant. The chicks in hunger may have attempted to swim from the island. They were active and running around on May 24th. There are lots of foxes (*Vulpes vulpes pusilla*) and Jackals in the area and only island nesting birds would be safe from their predation.

Some 2 kilometres further north were two more islands now inhabited by terns which were not in evidence on May 24th. The largest of these islands had an unmixed colony of Caspian terns numbering atleast 150 pairs. No other species were present and Natha my fisherman friend made several interesting observations. At least two nests contained 3 eggs, all the rest only 2 and most nests now had some decoration around the rim of bits of blackened *Salsola* leaves and stems. Also these nest were within two metres of each other. About ten per cent of the eggs were olive buff in ground colour and a few also beautifully marked with curly black lines. On the second island were about 30 Caspian terns nests and also 4 Gullbilled terns nests, two containing chicks. These were more grey than the gull chicks, with brownish red legs and fleshy pink at the base of their mandibles. A bluish darker area of naked skin through the eye and almost pure white throat and breast (a specimen preserved in formaldehyde was brought back). The downy wings were predominantly black.

Regarding other birds, there were many Whiskered terns (*Chlidonias hybrida*) hunting over the lake but no sign of breeding. Also we encountered on the May 24th visit, a colony of some 15 pairs of Blackwinged Stilts (*Himantopus himantopus*) on the first island. They build quite a thick pad of dried stems and leaves for a nest and some had a full clutch of four eggs. On the lake shore itself in the recently dried out part were pairs of Snowy or Kentish Plovers (*Charadrius alexandrinus*), and we stumbled across one nest on May 24th. This was under the shelter of a *Sueda* bush and its rim was decorated with tiny shells. Hopefully the Caspian terns can hunt for fish in Sonmeani Lagoon and they will rear their chicks, as these powerful terns dive deeply and can catch fish upto 20 cms in length.

Nearby Sonmeani is a very extensive lagoon averaging not more than 5 to 10 metres in depth. It is extremely rich in marine life with mangrove fringed shores, but a description of its ornithology is outside the scope of this note. Only one record seems appropriate to include. In early winter, shrimp fishing with throw nets is the most profitable occupation for the fishermen. The state of the tide is apparently critical for success and they commonly encamp overnight with their boats along the shores of the lagoon. Large Cormorants (*Phalacrocorax carbo*) are a favoured food at this time, the birds being skinned and roasted over open fires. In December 1977 a cormorant with a ring was shot, and though I failed to recover this ring, it apparently bore "foreign letters" on it and could have been Russian. During March I have often seen these cormorants in the distinctive breeding plumage of *Phalacrocorax carbo sinensis* which sub-species has a Russian breeding population. Later in the summer I have only seen birds in non-breeding or immature plumage and I cannot find evidence of local breeding. The Indian Shag (*P. fuscicollis*) does breed during the monsoon in the Sonmeani mangroves.

Surkhab Valley—Pishin District

Located at approximately 30° 35′ N and 67° 20′ E, the Valley is situated in Pishin District, approximately 45 kilometres due north of Quetta City and 65 km by road.

I first discovered the place in March 1974 and have been able to visit it in April, May or June each year subsequently. It is almost unique in the region as being one of the few places with a perennially flowing stream and some relatively well grown surviving tree cover which stretches for a distance of about 2½ km where the valley is so restricted by surrounding hills that it does not afford opportunity for cultivation. Two species regularly nest here which I have not been able to locate anywhere else in Pakistan, namely the Rufoustailed Chat (*Cercotrichas galactotes*) and Ménètries's Warbler (*Sylvia mystacea*) and the area seems worthy of recording in this note about the birds of Baluchistan. I have searched in vain for the Rufoustailed Chat in the Chaghai District, where Christison (1941) thought it probably bred.

The Valley itself is relatively flat and level with low surrounding hills of conglomerate and gravel. The Surkhab Lora, as it is called, is a shallow but fast stream flowing over gravel beds. The elevation is 1500 metres and average annual rainfall in Pishin town, 17 km distance, is 22 centimetres including light snowfall which falls every winter. It is severely cold and dry from October often until late March and has a relatively restricted resident bird population, but in summer it attracts a number of breeding migrants. On the gravel and shale hills abutting the valley are scattered bushes of *Artemesia scoparia, Prunus jacquemontii* (the wild almond) and spiny clumps of *Convolvulus spinosus* with showy white flowers in late April. In the valley floor itself are groves of *Populus* species and *Salix viminalis*, forming trees upto 10 metres height. in the open drier areas are a number of shrubs and thorny bushes; *Tamarix* species, *Berberis gambleana* and *Caragana ambigua* have been identified. There are also scattered brakes of the reed *Arundo donax*. In spring the ground is also carpeted with the hoary leaved vetchlike plant *Sophora alopecuroides*, which in April has creamy yellow flowers in a cluster at the tips of its stems. Clumps of the tall grass *Chrysopogon aucheri* also survive in the shelter of bushes, and though the area is heavily grazed by goats and cattle, there is good cover for nesting warblers.

My accumulated notes from five annual visits between 1974 and 1979 are summarised below, with more details covering the less well known species.

1. Little ringed plover **Charadrius dubius.** Breeding confirmed.
2. Kestrel **Falco tinnunculus.**

   No nearby suitable breeding cliffs, but a pair haunts the area each year.
3. See-See **Ammoperdix griseogularis.**

   Seen drinking from Surkhab in late evening and breeds in surrounding hills.
4. European or Common Kingfisher **Alcedo atthis.**

   Breeding confirmed.
5. Golden or European Bee-eater **Merops apiaster.**

   Nests in the earth cliffs. Excavation of the nest hole is a prolonged business and observed in one year, as late as June 29th.
6. Little Brown Dove **Streptopelia senegalensis.**

   Very common throughout Baluchistan.
7. Common Cuckoo **Cuculus canorus.**

   Seen every year and on May 2nd a proable egg found in a Brown Shrikes nest. See below.
8. Hoopoe **Upupa epops.**

   This species seems to nest in holes in earth cliffs as there are no suitable tree holes for nesting sites.
9. Red-rumped swallow **Hirudo daurica rufula.**

   This sub-species has a practically white rump but the breast is quite fulvous. They shun human habitation and nest upto 2700 metres elevation in the higher hills. At Surkhab they hawk insects along the valley and must nest nearby.
10. Magpie **Pica pica.**

    The most conspicuous bird in the valley and a family party of eight on June 29th seemed to confirm breeding. I have also seen its old unoccupied nests in the valley. It is an early breeder.
11. Brown Shrike **Lanius cristatus.**

    In the latest Palaearctic Checklist this species is *Lanius isabellinus*. The Russians call it *Lanius cristatus*, whereas in Sálim Ali's HANDBOOK it is listed as *Lanius collurio* (de Voous 1977, Ali 1972 and Dementiev *et al*. 1954). However, in all three instances the subspecies is the same *L. l. phoenicuroides* and this very distinctive bird is certainly the same species in all referred cases. It is Pakistan's rarest breeding Shrike and normally prefers higher elevations than Surkhab at least in Baluchistan. In fact I only saw it in one year out of five. Its nest, about 2 metres from the ground on a horizontal fork of a Willow tree, was not very neatly made but the cup was snugly lined with rootlets and shredded grasses. On May 2nd there were three pale pinkish buff eggs thickly speckled with grey and red brown forming a zone at the blunt end. A fourth egg was more green than turquoise with quite sparse red brown speckling. I presumed this was a Cuckoo's egg but it was the same shape and size as the other three eggs. Dementiev (op. cit.) records that in Turkestan this Shrike frequently becomes host to the Cuckoo (Page 19 Vol. vi). I note that in the HANDBOOK the ground colour of their eggs are described as greenish white. In Dementiev's account a reddish buff or pink ground colour is usual.

The Brown Shrike has many similar calls to other Shrikes, particularly the loud harsh rasping near the nest. The female was larger than her mate with a less darkly contrasting eye stripe. The male with shining white throat and upper breast, warm buff flanks and vent, has pinkish chestnut crown and tail; grey buff back and shoulders and his dark brown flight feathers were conspicuously bordered with paler buff. The eye streak seemed quite jet black and extends from the fore crown to well behind the eye.

12. Long tailed or Rufousbacked Shrike **Lanus schach.**

In every other year conspicuous breeding pairs in the valley.

13. Spotted Flycatcher **Muscicapa striata.**

This species normally breeds in the Juniper forest zone at higher elevations. I could not find its nest but at least one bird was haunting the tree groves every year and in March a pair were seen.

14. Menetries's Warbler **Sylvia mystacea.**

I first encountered this species in March 1974, a new record for the subcontinent (Roberts 1975). At the time I presumed it to be a spring passage migrant since such avid egg collectors as Williams & Christison (op. cit.) had failed to record it. I have searched in vain for a nest but the *Donax* thickets are impenetrable. It seems to arrive earlier and start nesting sooner than the Rufoustailed Chat. (They were plentiful on March 25th when no Rufous Chats were in evidence). I have seen a nest building male bird with a beak full of vegetable floss on May 2nd and on June 29th a family of at least three fully fledged young (with stubby tails and wisps of head down) were being fed by their parents who attracted me to the spot by their agitated alarm calls. In the whole valley I estimate there may be ten to fifteen pairs and in foraging, at least, their territories seem to overlap considerably. The male has a noticeable dark grey tail which is bordered with white outer tips as he dives into a bush. They feed well inside bushes and thickets rarely affording a clear view but are tame enough to allow approach to within 2 metres. Their contact call is the typically sylvine 'tak-tak-tak.' It is more diminutive than the lesser white throat and if it pauses long enough for a good view the brick red flush to its upper breast, prominent white malar streaks and red eye ring make it a striking and beautiful little warbler. I have recordings of its song which can continue uninterrupted for upto half-a-minute. I have only once seen it flutter into the air during the display song which is mostly given from well inside a thicket. It is quite melodious in short phases and to my ear superior to the song of the Sykes' Tree Warbler.

15. Rufoustailed Chat or Greybacked Warbler **Erythropygia galactotes.**

In habits this bird is very like the Indian Robin and the Himalayan Ruby Throat and therefore the name Chat seems much more appropriate than warbler. It feeds mostly on the ground running in little spurts at the end of which it raises its tail and often fans it. It only passes through Pakistan for a period of a few days in September on its return to its wintering grounds in North West Africa, and I was unfamiliar with the species until I learned where to find it in the hills around Karachi. The males probably arrive in the extreme border regions of Baluchistan in mid April and do not start vigorous territorial singing until early May. The sweet little song is always given from the top of a bush with the bird conspicuous and lasts two to three seconds, and may be repeated for upto a minute. It soon resumes feeding and then flies upto another bush to sing, travelling round its territory fairly systematically. Again I have failed to find a nest but *Donax* thickets with last year's dried stems encompassed by new green growth seem to be favoured and I never went to Surkhab armed with a suitable machete or billhook to cut open these thickets. However, on June 29th a pair were watched both carrying insect larvae and ants into a reed thicket and my annual observations leave no doubt that they are regular breeders. From territorial singing I estimated that there were 6 to 8 pairs in 1979.

16. Sykes Tree Warbler **Hippolais caligata rama.**

This bird is fairly wide-spread as a summer breeder in the lower valley of Baluchistan and they abound in the Surkhab valley. Their song is given almost continuously throughout the day in the breeding season. It is louder and coarser than that of Mènètries's warbler but like the latter invariably given from well inside a bush and during pauses between foraging for insects.

17. Pied Wheatear **Oenanthe picata picata.**

This bird forages in the valley bottom but nests in the surrounding low milk—a hole under a rock being favoured.

18. Pied Bush Chat **Saxicola caprata.**

No different from its habits in the plains.

19. Rock Pipit **Anthus similis.**

A nest with downy young was in a grass clump, perhaps fortituously well roofed over and concealed. This was right on the valley floor in sandy substrate.

20. Grey Wagtail **Motacilla caspica.**

Single birds seen and possibly breeding.

21. House Sparrow **Passer domesticus parkinii(?)**

Besides a small resident population in the towns, huge migrant flocks, shunning villages, sweep through in late March to early May presumably breeding further North in Afghanistan or Turkestan. But small colonies stay to breed in isolated valleys or higher hill-slopes where there is some tree-cover. The birds look bigger and more richly coloured than *P. domesticus indicus* and the subspecies *P. domesticus bactrianus,* which I would have expected, is supposed to be smaller and paler than the resident Indian race.

22. Trumpeter Bullfinch **Bucanetes githagineus** syn. **Rhodopechys githaginea.**

This thirsty little finch is rare in Central and Northern Baluchistan, commoner in the warmer more southern latitudes. I have seen it drinking from the Surkhab stream and it may well breed locally.

23. Striolated Bunting **Emberiza striolata.**

Also seen drinking from the stream and may well breed locally.

Birds like the Rock Nuthatch (*Sitta tephronota*), Orphean Warbler (*Sylvia hor-*

tense) and Desert Lark (*Ammomones deserti*) are typical of this elevation in Baluchistan but I have never encountered them in that particular patch of valley. I did not visit the valley late enough in the evening to identify any owls or nightjars.

REFERENCES

Ali, Salim and Ripley, S. D. (1968-72): Handbook of the Birds of India and Pakistan. Vol. I, Vol. III (Laridae) and Vol. V (Lanidae). Oxford University Press, Bombay.

Baker, Stuart (1929): Fauna of British India. Birds Vol. VI. Francis and Taylor, London.

Christison, A. F. P. (1941): Notes on the Birds of Chagai. *Ibis 1941*: 531-556.

——— (1942): Some additional notes on the distribution of the Avifauna of northern Baluchistan. *J. Bombay nat. Hist. Soc. 43*: 478-487.

Dementiev, G. P. and Gladkov, N. A. *et al.* (1954): Birds of the Soviet Union. Vol. VI. Moscow.

Hue, Francois and Etchecopar, R. D., (1970): Les Oiseaux du Proche et du Moyen Orient. Boubee & cie, Pare.

Meinertzhagen, R. (1914): Birds nesting at Quetta. *J. Bombay nat. Hist. Soc. 23*: 362-363.

——— (1954): Birds of Arabia. Oliver & Boyd Ltd. Edinburgh.

Roberts, T. J. (1975): Ornithological Records for Pakistan. *J. Bombay nat. Hist. Soc. 72*(1): 201-204.

Ticehurst, Claude, B. (1922-1924): The Birds of Sind. *Ibis.* Parts I to VIII.

——— (1926-1927): The Birds of British Baluchistan Parts I & II. Vol. 31 and Part III. Vol. 32.

Voous, de K. H. (1973): List of Recent Holarctic Bird species. *Ibis,* Vol. 115.

——— (1977): ibid. *Ibis,* Vol. 119.

Williams, C. H. and Williams, C. E. (1929): Some notes on the Birds breeding round Quetta. *J. Bombay nat. Hist. Soc. 33*: 598-613.

OBSERVATIONS ON FOOD AND GROWTH OF *BUFO MELANOSTICTUS* TADPOLE[1]

J. H. SABNIS AND KU. S. M. KUTHE[2]

(*With a text-figure*)

Studies on the food and its effect on growth in the tadpoles of *Bufo melanostictus* were undertaken to determine food preference in natural condition on the basis of prevalent of food items in guts of naturally occurring tadpoles. The faecal contents of the same tadpoles indicated as to which food items were digested. Tadpoles fed exclusively on spinach, *Spirogyra*, starch and detritus indicated that normal growth occurs when fed on Spinach and *Spirogyra*. Weight gain in the final stage of metamorphosis in *Bufo melanostictus* is remarkable.

To obtain a complete knowledge of the life histories and habits of each species it is necessary to study the relationship between the available food and larval growth rate.

The food and feeding habits of the frog *Rana tigrina* were studied in detail recently by Wadekar (1963), Joshee (1968), Isaac and Rege (1975). While Behura, *et al.* (1971) studied the diet and feeding habits of the common toad *Bufo melanostictus*.

The studies on the role of natural food on larval growth of tadpoles has received little attention in India except for the observations made by Kamat (1962) and Sabnis and Kolhatkar (1977).

This paper describes observations on the food and its effects on the growth of tadpoles of the toad *Bufo melanostictus*.

MATERIALS AND METHOD

The material for study was collected at Amravati (M.S.) (20° 56′ N. 77° 47′ E.) Breeding of *Bufo melanostictus* occurs from July to September and about 8,000 eggs are laid in long spiral strings, the diameter of the spiral strings is about 1.4 to 1.5 mm. Each egg measures about 1 to 1.3 mm. in diameter.

To study food preference and dietary components, data were obtained from gut and faecal analysis under microscope.

About 200 eggs were collected and kept in the laboratory for development. A set of twentyfive tadpoles were fed on different diets such as Starch, Spinach, Spirogyra and Detritus.

At intervals five tadpoles were collected from experimental sets as well as from Natural Pond for comparative growth studies. They were preserved in 10% formalin and their length and weights were recorded. Atmospheric and water temperatures were also recorded.

OBSERVATIONS AND DISCUSSION

The toad *Bufo melanostictus* is very common in ponds, puddles and tanks at Amravati.

Data on gut contents given in Table 1 reveals variations in dietary components at different growth stages. The apparent preference of food items is as follows:-

Eudorina > *Cosmarium* > Watermites >

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TABLE 1

DATA ON PERCENTAGE OCCURRENCE OF FOOD ITEMS IN THE GUTS OF TADPOLES OF *Bufo melanostictus*.
(Number—25 per stage)

Intestinal Contents	Prehind limb stage	Hind limb stage	Fore & Hind limb stage
Desmid	71.4	100	100
Diatom	85.7	100	100
Eudorina	100	100	85.7
Opalina	—	—	100
Spirogyra	14.2	57.1	14.2
Ulothrix	85.7	85.7	28.5
Euglena	57.1	71.5	57.1
Seemedesmus	71.4	14.2	14.2
Cosmerium	100	100	—
Watermites	100	—	—
Navicula	71.4	—	28.5
Closterium	—	85.7	—
Pleurococcus	100	—	—

Pleurococcus > Diatom > Desmid > *Closterium* > *Ulothrix* > *Euglena* > *Navicula* > *Spirogyra* > *Seemedesmus*.

The study of excreta revealed that they were able to digest *Spirogyra* and Spinach. The Diatoms, spores of *Eudorina*, and zoospores of *Spirogyra* remained unchanged in excreta. The *Eudorina*, starch granules, xylem and Phloem vessels were partially affected.

The time taken for the metamorphosis varies when fed on different food items (Table 2). It appears that on certain diets they metamorphosed successfully under laboratory conditions. The tadpoles fed on *Spirogyra* metamorphosed in 2 months and 11 days and those fed on Spinach metamorphosed in 2 months and 15 days, while in nature they metamorphosed in 2 months and 6 days.

The weight gain percentage by tadpoles fed on different food items and their percentage of successful metamorphosis is given in Table 3. The maximum increase in their average body weight 31.86%, was when there were fed on Spinach, though the gain of weight by them showed considerable variations at different growth stages.

During the entire period of successful metamorphosis of *Spirogyra* and Spinach fed tadpoles, the tadpoles which were fed on starch, detritus remained in prehind limb stage only.

It is also interesting to note that under laboratory condition tadpoles metamorphosed successfully when fed on *Spirogyra;* but their average body weights at different stages were half that of Spinach fed tadpoles (Table 3).

Sabnis and Kolhatkar (1978) observed that tadpoles of frog *Rana cyanophlyctis* fed on *Spirogyra* showed maximum increase in their average body weight, i.e. 74 per cent. But in the present observations, tadpoles feeding on *Spirogyra* showed increase in average body weight, i.e. 29.36 per cent.

In conclusion it may be pointed out that simple analysis of gut contents of tadpoles does not give clear idea of its food habits. Kamat (1962) studied the gut contents of

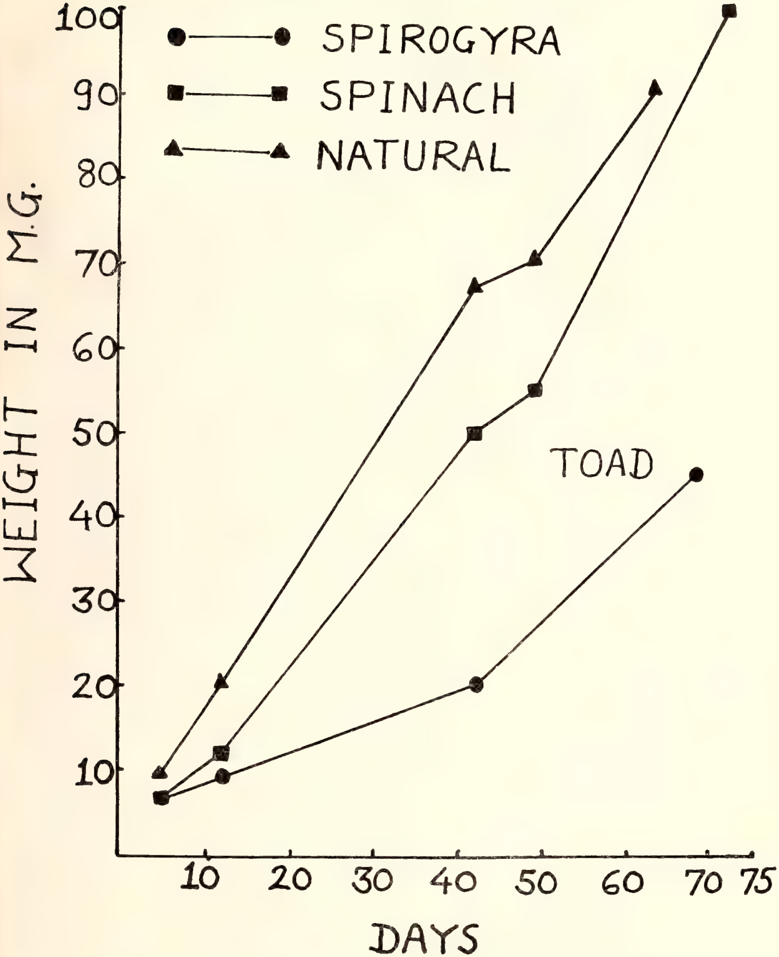

Fig. 1. Shows the comparative growth of *Bufo melanostictus* tadpoles fed on different diets.

TABLE 2

DATA ON GROWTH OF *Bufo melanostictus* TADPOLES (EXPRESSED AS MEAN ± S.E.) (For 5 tadpoles per stage)

Date	Spirogyra fed			Spinach fed			Naturally fed		
	Length in m.m. ± S.E.	Weight in mg. ± S.E.	Temp. °C.	Length in mm. ± S.E.	Weight in mg. ± S.E.	Temp. °C.	Length in m.m. ± S.E.	Weight in m.m. ± S.E.	Temp. °C.
29th July '77—Egg spawn & Hatched Tadpole:—0 hour									
5-8-77	7± .46	7± .81	27°C.	10±1.25	7± .53	27°C.	7± .74	9± .93	27°C.
12-8-77	8± .81	9±1.06	29°C.	11± .79	12± .93	29°C.	10±1.06	20± .93	30°C.
12-9-77	10± .57	20±1.04	27°C.	16± .93	50± .93	27°C.	21±1.11	67±2.95	27°C.
19-9-77	12±1.41	27±1.74	27°C.	18± .93	55±1.99	27°C.	22±1.58	70± .60	29°C.
Metamorphosed Toad									
3-10-77	—	—	—	—	—	—	10± .61	90±1.27	28°C.
8-10-77	9±1.23	45±2.04	27°C.	—	—	—	—	—	—
12-10-77	—	—	—	12±1.63	100±1.22	28°C.			

TABLE 3

SHOWS BODY WEIGHT GAIN BY TADPOLES OF *Bufo melanostictus* FED ON DIFFERENT DIETS AND PERCENTAGE OF SUCCESSFUL METAMORPHOSIS

Food item	Number of Tadpoles	Average body weight gain percentage for				Percentage of Metamorphosis
		Pre hind limb stage	Hind limb stage	Hind & fore limb stage	Average	
Spirogyra	25	22.2%	25.9%	40%	29.36%	20%
Spinach	25	41.6%	9 %	45%	31.86%	32%
Starch	25	10 %	—	—	—	0%
Detritus	25	20 %	—	—	—	0%

tadpoles and algae of small ponds and came to the conclusion that tadpoles do not feed on all available algae. In 1941 Rugh states, "the anura do better on food wih green colour while Urodela do better on living moving food such as Daphnia".

Sabnis and Kolhatkar (1978) observed in *Rana cyanophlyctis* decrease in body weight in the final stage of metamorphosis, i.e. after shedding of the tail. No such decrease in body weight was observed in the present investigation. On the contrary in the tadpoles of *Bufo melanostictus* a progressive increase in weight was maintained throuughout the process of, metamorphosis (Fig. 1). This disparity may be either due to the comparatively bigger size of the tail in *Rana cyanophlyctis* or it may be due to a better tolerance of the change in feeding habit from herbivorous to insectivorous feeding in *Bufo melanostictus.*

ACKNOWLEDGEMENTS

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REFERENCES

BEHURA, B. K., DAS, P. K., MOHANTY, P. AND GHOSH, G. S. (1971): On the diet and feeding habits of the common toad *Bufo melanostictus* Schneid. *Prakruti—Utkal University Journal of Science 8*(1): 79-86.

BRIGGS, R. AND DAVIDSON, M. (1942): Some effects of Spinach feeding on *Rana pipiens tadpoles. J. Exp. Zoo. 90*: 401.

ISAAC, S. AND REGE, M. S. (1975): Food of *Rana tigrina* (Daud.). *J. Bombay nat. Hist. Soc., 72*(1): 143-157.

JOSHEE, A. K. (1968): Food habits of the Bull frog *Rana tigrina* (Daud.). *J. Bombay nat. Hist. Soc., 65*: 498.

KAMAT, N. D. (1962): On Intestinal contents of tadpoles and algae of small ponds. *Curr. Sci. 31*: 300-301.

RUGH, R. (1941): Experimental Embryology Mennesota, Burgess publishing Company.

SABNIS, J. H. AND KOLHATKAR, B. L. (1977): Observations on the food preference of *Rana cyanophlyctis* tadpoles. *Comp. Physiol. Ecol.* 2 (4): 232-233.

SABNIS, J. H. AND KOLHATKAR, B. L. (1978): Observations on the growth of *Rana cyanophlyctis* tadpoles ibid. *3*(2): 71-72.

WADEKAR, U. L. (1963): The diet of the Indian Bull frog (*Rana tigrina* Daud.). *J. Bombay nat. Hist. Soc. 60* (1): 263-268.

DISTRIBUTION OF MOLLUSCS IN AND AROUND THE CORAL REEFS OF THE SOUTHEASTERN COAST IN INDIA[1]

C. S. Gopinadha Pillai and K. K. Appukuttan[2]

(*With three plates, four text-figures and a map*)

Introduction

The report presents the results of a synecological analysis of the molluscan fauna associated with the different hard and soft substrates in and around the fringing coral reefs of Palk Bay and Gulf of Mannar around Mandapam (Map 1) between the longitudes 79° 8′ and 79° 14′ E, and latitudes 9° 12′ and 9° 18′ N. This study forms part of a programme of survey of the reef-associated living resources of the seas around India. An attempt has been made to identify and to assess the comparative dominance of the molluscan communities in the different habitats as also to delineate the physical and biological factors that influence their selection of habitats.

The molluscs of this area are fairly well known, thanks to the works of Hornell (1915, 1917, 1922, 1951), Gravely (1927), Satyamurthi (1952, 1956), Rao (1970), Jones (1970), Silas (1968) and many others whose contributions are listed by Nair and Rao (1974). Though about 450 species are known from this area, there appears to be little attempt in the past to discuss the synecological aspects of molluscan distribution but for the work of Rao and Sundaram (1972). Satyamurthi (1952, 1956) has mentioned the natural habitat of many species he has described. The present collection includes only 112 species (Table 2)—roughly one fourth of the known species, partly because we have not accounted the many dead shells found except from the raised reefs. In the recent past there has been considerable destruction to reefs due to indiscriminate quarrying of corals and this has directly caused a dwindling of the molluscs associated with the reefs. (Pillai 1975).

Materials and method

Sixteen stations (Map 1) were selected, representing almost all the types of specialised habitats seen in this region.

The collections were made at low tide with the aid of face mask and snorkel, where depth permitted. In Palk Bay, the survey was carried out during August-September; in Gulf of Mannar, during January-February; when calm conditions prevailed. The unit for the survey and population analysis was a sample plot of quarter square metre marked out with the aid of a metal frame. In addition to these observations and analyses relevant portions of our earlier studies on corals (Pillai 1971a, 1972) and on boring bivalves (Appukuttan 1972) were also incorporated to make the account comprehensive. The nomenclature of the various intertidal zones used in this work is that of Lewis (1955, 1961 & 1972), and Newell (1969).

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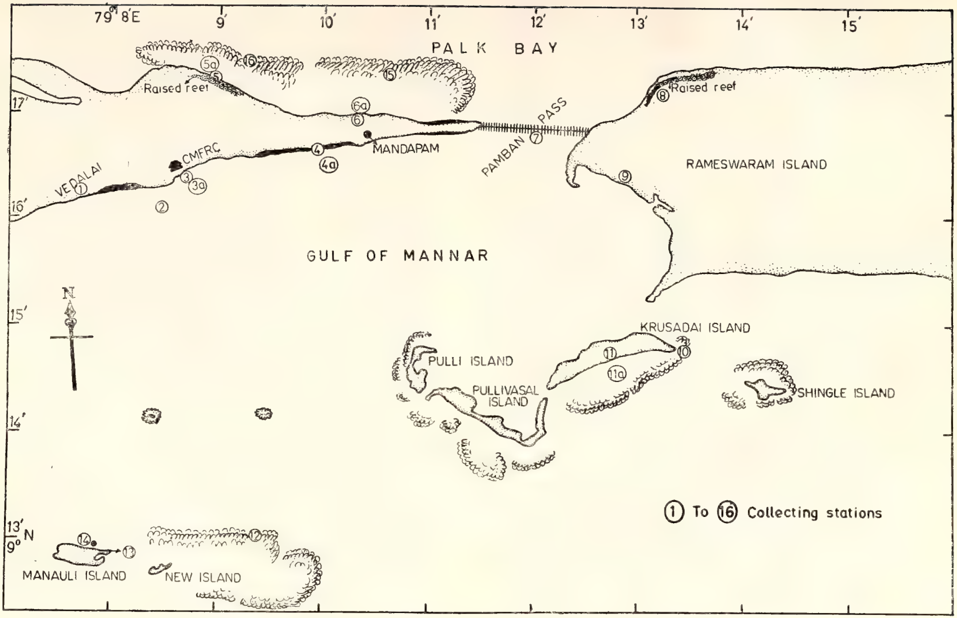

79° 8'E
9'
10'
11'
12'
13'
14'
15'
PALK BAY
Raised reef
⑤
⑤a
⑯
⑮
⑥a
⑥
17'
MANDAPAM
PAMBAN PASS
⑦
④
④a
CMFRC
③
③a
VEDALAI
①
②
16'
⑧
RAMESWARAM ISLAND
⑨
GULF OF MANNAR
N
15'
KRUSADAI ISLAND
⑩
⑪
⑪a
PULLI ISLAND
PULLIVASAL ISLAND
SHINGLE ISLAND
14'
① To ⑯ Collecting stations
13' N
9°
⑭
⑬
⑫
MANAULI ISLAND
NEW ISLAND

Map. 1. Area of investigation with different collecting Stations.

Details of stations studied:

Station 1. Vedalai, Gulf of Mannar. Sandy beach with open circulation, not protected by a reef. Dominated by Wedge-clams.

Station 2. About 700 m east of station 1 Sublittoral zone. Sandy bottom with seagrass bed. Depth about 0.5 m at low tide with a very high concentration of *Pinna bicolor*.

Station 3. About 300 m further east of station 2 below the CMFR Institute Jetty in Gulf of Mannar. The groyne of the Jetty in the upper zone provides an artificial habitat and is designated as 3, whereas the lower zone, about 50 m into the sea with a depth of about 50 cm at low tide, is marked 3a. Station 3a has a rich growth of higher algae. The upper zone is typical eulittoral while lower zone is sublittoral.

Station 4. About 1 km east of station 3 in Gulf of Mannar. The station slopes steeply from the elevated sandstones on the shore at a height of nearly 2 m to the low water mark. (Pl. 1, Figs. 1, 2) The upper part of the sand stones represents the littoral fringe zone while the lower zone is typically eulittoral. Littorinids are the dominant molluscs.

Station 5. Manacadu Point on the Palk Bay side of the Mandapam peninsula with remnants of a raised reef. Semifossilised coral boulders on the water mark which harbour many gastropods and is marked 5, is typically eulittoral. (Pl. 3, Fig. 1). The semifossilised coral boulders in the lagoon bottom at a depth of 0.5 to 0.75 m at low tide, marked station 5a, is sublittoral with a dominant assemblage of bivalves.

Station 6. The landing centre at Mandapam in Palk Bay. The upper sandy beach in the eulittoral zone, marked station 6, and the lower sublittoral with algal growth and sandy bottom is 6a. (Plate 3, Fig. 2).

Station 7. The blocks of sandstones under the Pamban Bridge subjected to heavy current, mostly submerged with a luxuriant growth of edible algae on them.

Station 8. Northwestern tip of the Rameswaram Island on Palk Bay side. A raised reef with an elevation of nearly 1.5 m. Equivalent to Littoral fringe zone.

Station 9. Western side of Rameswaram Island near the Pamban bridge. Sandy eulittoral zone.

Station 10. Eastern tip of Krusadai Island in the Gulf of Mannar where the reef with a boulder zone approaches the shore. Eulittoral, with a dominance of gastropods. This is the only undisturbed reef available for investigation at present here.

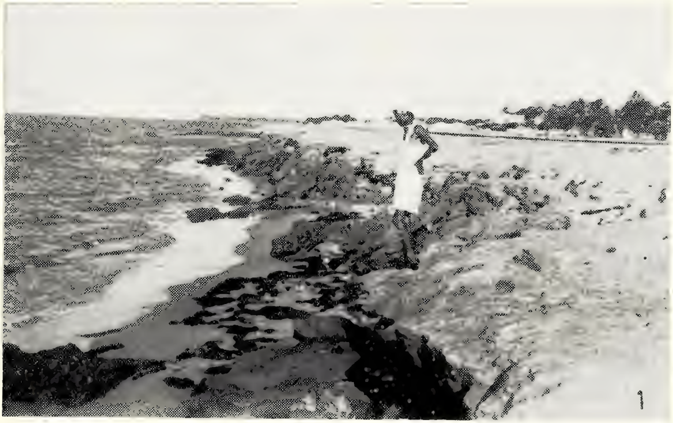
Station 11. Sandy beach at the southern side of Krusadai Island. A lower zone in the lagoon with corals and algae is designated as 11a. The beach is protected by a fringing reef.

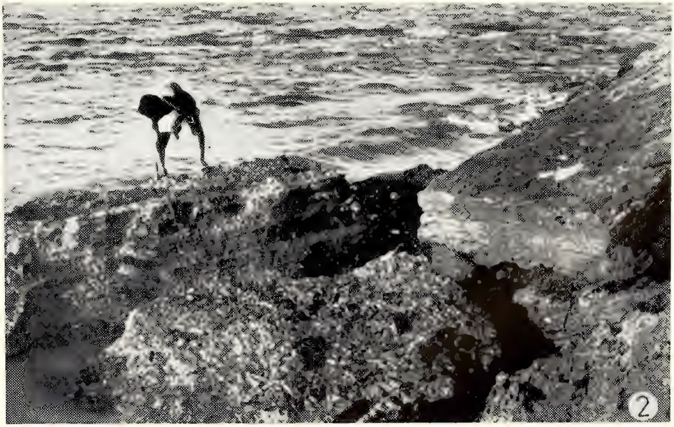
Station 12. The reef of Manauli Island in Gulf of Mannar. The reefs have mostly been removed and only a few scattered, dead, upturned colonies of *Acropora* and *Porites* are seen, with intermittent large areas of sand.

Station 13. The lagoon of Manauli Island. Bottom sandy with sea grass and other edible algae. Mostly submerged and represents the sublittoral zone. The nearshore area is without vegetation and gets exposed at low tide.

Station 14. A mangrove growth at the northeastern shore of Manauli Island. A mud flat, that gets exposed fully at low tide, and teaming with *Cerithidea*, adjoins the mangroves.

Stations 51 *and* 16. The reef of Palk Bay along the Mandapam Peninsula. The reef crest, outer and inner sides of the reefs were investigated. The outer reef shows a preponderance of ramose corals while the inner (shoreward) side is rich in massive corals (Pillai





1. Beach sandstones at Station 4.
2. Closer view of the square cut blocks.

1. Exposed lagoon bottom at Mandapam Palk Bay showing the unvegetated sand, west of Station 5.

2. *Ulva reticulata.* Large quantities are found washed ashore during September in Palk Bay shore habitated by several gastropods.

1971a). The reef crest is typical eulittoral and is devoid of any living corals.

THE MOLLUSCAN ASSEMBLAGES IN DIFFERENT HABITATS

Sandy shore

(Without vegetation)

The mainland coast along Mandapam and the shores of the near by sand cays in Gulf of Mannar (Stoddart and Fosberg 1972) are mostly sandy, though outcrops of sandstones are found along the mainland coast. Typical rocky shore does not exist. The beach sand is fine-grained, the grains ranging from 2 to 4 mm in size and with an admixture of corals and molluscan shells. The molluscan fraction is mostly of the shells of *Cerithium, Umbonium, Dentalium,* and *Donax*. The subsurface has a high percentage of black clay (at a depth of 10 cm and below) with a foul smell of hydrogen sulphide. At Mandapam (Palk Bay) the grain size increases towards the deeper layers with an unconsolidated grit of gastropod shells. The grain size as well as the calcareous content of the beach sand varies from place to place. At station 1 the sand is 0.5 to 1.5 mm in grain size and a sample from the surface yielded 85.66% of insoluble silicon in hydrochloric acid and 14.44% soluble calcareous matter. However, the beach sand of the islands has a very high percentage of calcareous matter. Analysis of a sample from station 11 in Krusadai Island yielded 96.48% of soluble calcareous matter in hydrochloric acid. The high calcareous content in Krusadai is mostly due to the presence of coral fragments. The following discussion of the molluscs of sand is based on stations 1, 6, 9 and 11.

At the low water mark, *Murex trapa, Bursa spinosa, Drupa margiriticola* and *Cerithium* spp. are present. During December, 1973 and January, 1974 *Aplysia lineolata* was found in fair numbers at Vedalai. The mud flat at the northern side of the Manauli Island which gets exposed at low tides harboured plenty of *Cerithidea fluviatilis*, their number varying from 100 to 150 per square metre. However, along the mainland coast this gastropod is rare and replaced by *Cerithium trailli*.

On the eulittoral beaches the molluscan fauna is rich, composed of *Donax* spp. and *Atactodea glabrata* with a high concentration of the individuals at the mid-beach at a depth of 20 to 25 cm. The deeper muddy substraum is unsuitable for these filter feeders. However, there is local variation in the occurrence and abundance of these two genera of burrowing bivalves. *Donax* spp. are common along the mainland coast. At Station 1 their concentration was 40 to 60 individuals per square metre in January, 1974, represented mainly by *D. faba* and *D. cuneatus*. Alagarswami (1968) reported a concentration of 89 to 217 clams from the same site during December 1962 to November, 1963. He has also reported the presence of *D. spinosus, D. apertus* and *D. incarnatus* at Vedalai, however, our collections during January, 1974 yielded none of these species. On the Palk Bay side the intensity of *Donax* was less, only 10 to 15 individuals/sq. metre were recorded. This may be due to the more muddy nature of the subsurface sand along Palk Bay coast. At station 1, though *D. faba* and *D. cuneatus* occur, there seems to be a sort of grouping among the species, i.e. individuals of the same species incline to concentrate. When one sample plot yielded one species, another plot yielded only the other though both *faba* and *cuneatus* are found at the same level of the beach. Further, individuals from the same plot are more or less of the same size probably of same age. This shows that there is very little tendency among the members to disperse. The burrowing clams of the islands are predominantly *Atactodea glabrata* (20-30/sq. m in Krusadai). *Donax faba* and *D. cuneatus* are rare.

The ecological factors that determine such a distribution of *Donax* along the mainland coast and *Atactodea* on the island are not clear. The calcareous content of the beach sands on the islands, as already mentioned, is much higher than that of the mainland coast. Further, the mainland coast is subjected to more wave action and beach circulation than the islands protected by the fringing reef. The tendency of *Donax* to concentrate on unprotected beaches with high circulation of water was already pointed out by Taylor (1968). He also stated that though *Donax faba* and *Atactodea glabrata* may occur in the same beach at Mahe, Seychelles, the latter species always occupies a higher and more sheltered position on the beach. In general, our observations also show that protected island beaches with a high calcareous content in this area form a favourable habitat for *Atactodea,* while fine-grained sand with very little calcareous content, with good water circulation, is the more favoured habitat for *Donax* spp.

The sandstones :

Blocks of elevated sandstones are found along the Mandapam Peninsula on the Gulf of Mannar side. A small outcrop is seen near the Pamban Bridge at the Palk Bay side also. The sand cays situated in the vicinity of Mandapam are devoid of any sandstone outcrops (Stoddart and Fosberg 1972), though Reddiah (1972) has reported its occurrence along the beaches of Appa Island, further north, in the Gulf of Mannar. The sandstones are elevated up to 2 m in certain places showing signs of wave-cut aberrations. Structurally, they are conglomerate of sand grains of different sizes with molluscan shells, predomi-

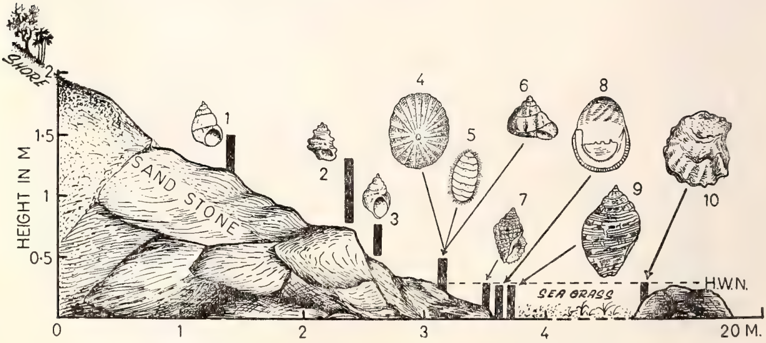


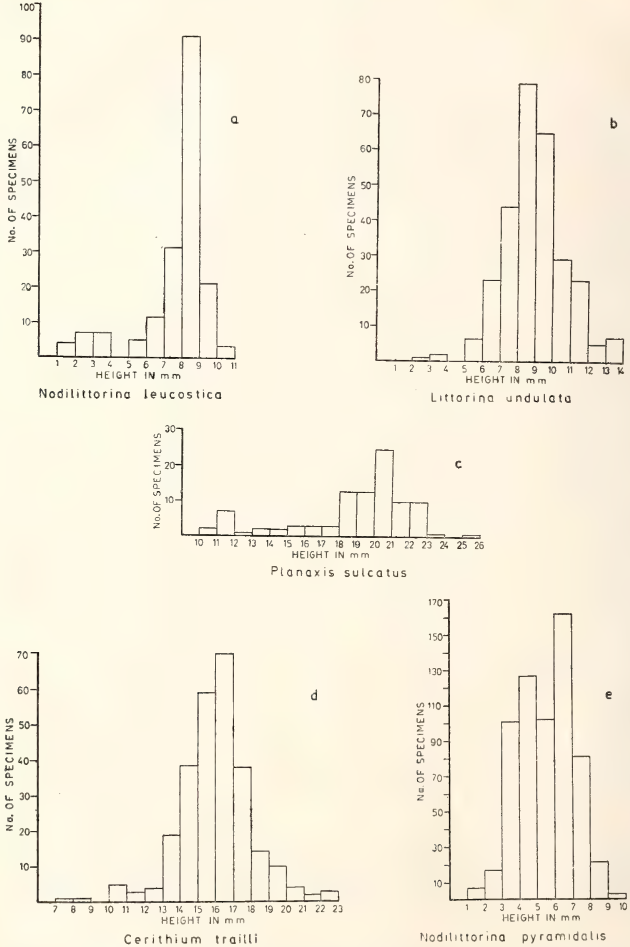
Fig. 1. Zonation of various molluscs at Station 4. The thick vertical lines show the vertical range of species. 1. *Littorina undulata;* 2. *Nodilittorina pyramidalis;* 3. *N. leucostica;* 4. *Cellana radiata;* 5. *Craspidochiton* sp.; 6. *Trochus radiatus;* 7. *Drupa margeriticola;* 8. *Nerita* spp.; 9. *Thias* (*Purpurea*) *rudolphi;* 10. *Crassostrea cucullata.*

nantly of *Cerithium*. The sandstone assemblage of molluscs discussed below is based on observations at station 4.

In the absence of any rocky outcrops in this area, the typical rocky shore animals occupy the sandstones. At station 4 the molluscan fauna display a pattern of vertical zonation (Fig. 1). At the higher levels representing the Littoral fringe zone (Lewis 1961, Morton and Challis 1969, Newell 1970, Arudpragasam 1970) the dominant animals are the littorinids. At a height of nearly 1.75 m from the high neap tide level *Littorina undulata, L. krausi* and large individuals of *Nodilittorina pyramidalis* are found. The first mentioned species is found at the highest zone and displays a lot of phenotypic variations in the colour of their shells. It has a tendency to crowd together under the overhanging cliff and in crevices. The species is not generally seen on the surface of sandstones exposed to scorching sun. *L. krausi* is rare here. Though *Nodilittorina pyramidalis* is found mixed with *L. undulata* its concentration is at a lower level, where they have a tendency to flock together, sometimes in hundreds as we observed in January, 1974. Lower down, below the zone of *N. pyramidalis,* there is a heavy concentration of *Nodilittorina leucostica* where there is a constant splash of water. From a sample plot we collected as many as 621 specimens of *N. pyramidalis* and from a plot below that 180 specimens of *N. leucostica*. However, we have not observed a zone where these two species mingle, the position of the former being always above the level of the latter. Among the four species of littorinids found here, *N. pyramidalis* has the widest range of vertical distribution from the upper limit of the littoral fringe to the upper limit of the eulittoral zone. The younger specimens occupy a lower level while the large adults migrate to the upper level of the littoral fringe. A similar pattern of vertical distribution of this species at Ceylon was recorded by Arudpragasam (1970), while Atapattu (1969) observed a similar phenomenon in *N. granularis*.

Size range and density of population of littorinids at station 4 during January, 1974 was analysed. In random samples of 284 specimens of *Littorina undulata,* the height of shells ranged from 2 to 13.8 mm, the majority being in the range of 8 to 10 mm (Fig. 2b); only 10 specimens were in the range of 1 to 6 mm. 180 specimens of *N. leucostica* examined from a sample plot ranged 1 to 11 mm, the maximum number being in the range of 8 to 9 mm (Fig. 2a). A sample plot yielded 621 specimens of *N. pyramidalis* ranging from 1 mm to 10 mm, the maximum being in the range of 6 to 7 mm (Fig. 2 e). Presence of small specimens in the range of 1 to 2 mm in the natural population of littorinids suggests that breeding and recruitment of individuals to the population occur shortly before January. On the Ceylon coast recruitment of *N. granularis* to the population takes place at the tail end of Southwest monsoon, i.e. during October to November (Atapattu 1969). This seems to be true of all the members of the *Littorina* and *Nidilittorina* of this area.

Below the zone of littorinids (eulittoral zone) occur the limpets *Cellana radiata* and a small species of *Craspidochiton*. The edible oyster *Crassostrea cucullata* is seen fully exposed at low tides, the habitat of which in general is within a narrow belt between tide marks (Hornell 1951). They attach firmly to the sand stones. At low water marks the carnivorous gastropod, *Thias* (*Purpurea*) *rudolphi* and *T. carnifera* as well as *Drupa margiriticola* are seen. *Cerithium trailli* are also found in fair numbers. Very rarely the eulittoral sandstones are found to have the boring



Nodilittorina leucostica

Littorina undulata

Planaxis sulcatus

Cerithium trailli

Nodilittorina pyramidalis

Fig. 2. Size range of some intertidal gastropods collected from sample plots at different stations. a. *Nodilittorina leucostica* from Station 4, during January, 1974. No. of specimens measured 180. b. *Littorina undulata* from Station 4, January, 1974, based on 284 specimens. c. *Planaxis sulcatus* from Station 5, September, 1973, based on 96 specimens. d. *Cerithium trailli* from Station 5, September, 1973, based on 271 specimens. e. *Nodilittorina pyramidalis* from Station 4, January, 1974, based on 621 specimens.

bivalve, *Lithophaga* (Appukuttan 1972).

Raised reefs

The raised reefs of Ramanathapuram in South India are already described (Foote 1889, Sewell 1935, Stoddart and Pillai 1972). Two stations, 5 and 8 were studied for their living molluscs, and were found to be mostly similar to the elevated sandstones discussed earlier. This includes both the littoral fringe and eulittoral forms.

Mangroves

Mangroves are characteristic of areas with variable salinities, muddy or sandy bottom and calm conditions (Cooman 1969, Macnae 1968, Macnae and Kalk 1962). The molluscan fauna of mangroves in general includes a limited number of gastropods and bivalves. There appears to be no earlier information on the mangrove fauna of this area, though Stoddart and Fosberg (1972) have recently listed the vegetation and discussed the zonation at Manauli Island (Station 14). The molluscan fauna associated with the mangroves can be broadly divided into those that actually live on the vegetation and those that live around. At station 14 the mangroves are of *Avicennia marina, Bruguiera cylindrica* and *Rhizophora mucronata. A. marina* forms a low wooded forest. According to Macnae and Kalk (1962) the animals found in the mangroves are only fortuitously associated depending on the level of water table, resistance to waterloss, demand for protection from sun, degree of consolidation of substratum and availability of food.

The breathing roots of *Avicennia* at Manauli Island are inhabitated by *Planaxis sulcatus* often mixed with *Littorina melanostoma.* They are found 50 cm above the lowest watermark. On the trunks and leaves of trees, *L. scabra* occupy upto one and a half metres from the ground level. Other conspicuous animals on the roots are the barnacles. The spaces among the breathing roots in the eulittoral zone harbours *Cerithidea fluviatilis* in plenty. The gastropod *Cassidula* sp. was also collected. The only bivalve we could find in the ground was *Gafrarium tumidum,* a species that is found commonly in several other habitats.

It is interesting to compare the mangrove-associated molluscs of this area with those of the East Indies and Western Indian Ocean, though the information from this part is by no means complete. Both *L. melanostoma* and *Cassidula* sp. are listed as true mangrove forms of the East Indies (Cooman 1968). *Cerithidea* is common to East Indies and Indian Coast, but the species listed by Cooman from the East Indies is different. Cooman (1968) lists 20 species of molluscs from the East Indies against six species we have collected from here. *Isognomon, Crassostrea, Modiolus* and *Teredo* found in the mangroves of East Indies do occur in other habitats in south India, though we could not collect any of them specifically from the mangroves we investigated. *L. scabra* is common to southern and western Indian ocean mangroves (Taylor 1968) but is not known from East Indies. *L. melanostoma* found in southeast coast of India and eastern Indian mangroves is not listed from western Indian ocean. In this respect, our mangroves have faunal elements from both eastern and western Indian oceans. However, there is need for more intensive collection of the faunal elements of our mangroves.

Eulittoral Boulders

a. *Semifossilised loose lying corals*:

At Manacadu Point (Station 5) the raised reef gradually dips into the sea with a lot of semifossilised loose lying coral boulders of *Favia, Favites, Platygyra, Porites, Goniastrea* and *Acropora* having a coating of green algae. The boulders are exposed at almost every tidal change and are covered only at the spring tides. These were found to be an ideal habitat for many algal grazing gastropods. *Planaxis sulcatus* are abundant and occupy the highest position in the vertical range of distribution. They show a tendency to crowd together in small crevices and depressions of the boulders and those of the same size are found together. In September, 1973 there were 120 to 130 individuals per square metre and their size ranged from 10 to 25 mm. Very small animals were not seen and this suggests that their reproductive period probably coincides with that of *Littorina* at the tail end of the southwest monsoon. The size range of 96 specimens, all from a sample plot is presented in Fig. 2C, and it shows that the maximum number of individuals was within the range of 20 to 21 mm. *Onchidium verruculatum* was very common on the undersides of the boulders inhabitated by *Planaxis*. At fully exposed condition, four to five individuals were found crowded together in crevices. Lower in the vertical range there is a preponderance of *Cerithium trailli*. The zone of *Cerithium* is subjected to lesser duration of exposure than the zone of *Planaxis*. There is a clear-cut demarcation between the zones of *Planaxis* and *Cerithium* and we failed to observe any mingling of the two genera. It is likely that *Cerithium* is less tolerant to exposure than *Planaxis*. The number of individuals of *Cerithium trailli* per square metre averaged 286 with an average total weight of 204 gm. In size they ranged from 7 to 22 mm during September, 1973; specimens of smaller size were apparently absent. The maximum number of individuals was seen in the size range of 10 to 17 mm (Fig. 2d). From the analysis of the size range of individuals during September, it is clear at these gastropods also breed during the tail end of southwest monsoon as in the case of littorinids. The smallest ones (7 to 8 mm) belonged to the latest brood.

Below the zone of *Cerithium, Nerita* was very common, represented by at least three species, *viz. N. maura, N. albicella* and *N. chaemelon*, found in a totally exposed condition. Mingled with *Nerita* were seen four species of *Gafrarium, viz. G. pectinatum, G. dispar, G. divaricatum* and *G. tumidum;* however, *Gafrarium* has a wider range of habitat selection and is often found on the sandy and vegetated lagoon bottom. *Crassostrea cucullata* is common here.

b. *Eulittoral granite boulders*:

At station 3 the groynes of the jetty form an excellent artificial habitat for many gastropods. At low tide, these blocks get exposed for a long time, and reveal underneath the loose boulders, several species such as *Purpurea rudolphi, P. carnifera. Conus amadis, C. coronatus, Cyprea moneta, C. caputserpentis* and *Aplysia lineolata* occur. On the surface of boulders *Trochus radiatus* and *Turbo intercostalis* were seen. Bivalves were not seen, though *Mytilus*, recently introduced by the Institute, for mariculture experiments was thriving.

c. *The reef crest and reef flat*:

There seems to be no well demarcated reef crest or reef flat in this area since the fringing shallow reefs have not developed into a well consolidated structure. Further, whatever existed has been destroyed in many places. In an earlier paper Pillai (1971a) used the term reef crest to denote the highest part of the reef in Palk Bay. This part of the reef is

1. The raised reef and eulittoral coral boulders at Station 5, teamed with *Planaxis* and *Cerithium*.

2. Eulittoral sandy beach at Mandapam Palk Bay, where *Donax* is plenty. One of the Sample plots is seen in foreground.

composed of dead boulders subjected to intermittent exposure as in a typical reef flat. An area similar to reef flat with a boulder zone is present at Krusadai Island (Station 10) and is subjected to heavy breakers. In the Palk Bay, *Trochus radiatus, Turbo intercostalis, Astrea semicostata* and *Drupa margiriticola* are seen at the top of the boulders subjected to prolonged exposure at low tides. On the sides of the boulders, at a lower level, *Arca* spp. and *Isognomon isognomon* are rarely seen. *Crassostrea cucullata* is common. *Pinctata* sp. is also rarely seen. At Krusadai (Station 10) the fauna was found to be rich and varied, probably due to the undisturbed condition of the reef. Gastropods were very common and were represented by *Cerithium morus, Pyrine versicolor, P. zebra, Drupa margiriticola, D. tuberculata, D. horrida, Cyprea arabica, C. moneta, Trochus radiatus, Turbo intercostalis, Thias (Purpurea) rudolphi, Cantharidus undosus,* and *Nerita albicella.* Among the Amphineura a species of *Ischnochiton* was very common. Bivalves were poorly represented, but for the presence of young specimens of *Crassostrea cucullata.*

The submerged or sublittoral habitats

a. *The unvegetated sand*:

At several spots in Palk Bay and Gulf of Mannar, the bottom sand is clean and fine grained, (Pl. 2, Fig. 1) with an admixture of clay and dead shells at the subsurface, often with a foul smell. The muddy subsurface is unsuitable for burrowing bivalves and digging scarcely revealed the presence of any infauna. On the surface, *Drupa margiriticola, Cerithium* spp., *Murex tarpa,* and *Bursa spinosa* are generally seen. However, the ideal habitats of all these animals are elsewhere, and many bivalves are seen either lying on the surface or partly buried, like *Gafrarium tumidum.* At Manauli Island, *G. tumidum* is found along with *Mactra cuneata, Dosinia cretacea* and *Mesodesma trigona.* The mud flats were found to be teeming with *Cerithidea fluviatilis* in Manauli Island. The other gastropods rarely seen are *Nassa thirstis* and *Polinices mamilla,* the former generally harbouring a symbiotic anemone on the shell. The younger specimens of *P. mamilla* are purple whitish while the adults are milky white and feed on bivalves (Taylor 1968). *Cardium edulae* occurs in Palk Bay and their dead shells are found on the surface. Rarely *Pinna bicolor* is seen half buried in sand, though it is abundant on seagrass beds.

b. *Submerged dead coral shingle*:

At Station 5a, the lagoon bottom is strewn with loose, semifossilised coral boulders with intermittent sandy areas. The nature and composition of the boulders are similar to those already described from Station 5. The sandy areas have many algae like *Sargassum, Padina, Turbinaria* and the calcareous alga *Amphiroa.* For details of the algae reference may be made to Rao (1972). The depth at lowest tide is about 50 cm. These boulders harbour a rich and varied fauna of molluscs, especially bivalves. Most of them are found attached to the boulders, the most common being *Arca* represented by at least three species, *viz. A. symmetrica, A. avellana* and *A. complanata.* The swimming bivalve *Galeomma paucistriata* occurs in fair numbers. It is pale yellowish white with a dark brown prolongation of the mantle in the living condition (Satyamurthi 1956). Yet another very common bivalve seen here is *Scintilla,* represented by two species, *viz. S. hanleyi* and *S. timorensis. Vulsella vulsella* with its commensal sponges is fairly common. *Isognomon isognomon* and *Pinctada anamoides* are found in fair numbers. The larger specimens of *P. anomoides* ranged from 50 to 65 mm in length. Gastropods are by no means a conspicuous element in the fauna of this habitat, though *Drupa margiriticola, Cerithium trailli, Turbo intercostalis, Cellana radiata* and *Eumarginula obovata* are represented.

c. *The sea grass fauna*:

At station 2, 6a & 13 the sea grass vegetation is composed of *Cymodocea rotunda, C. serrulata, Halodule* sp. *Syringodium isoetifolium* and *Thalassodendron ciliatum* (Stoddart & Fosberg 1972). They are locally abundant at several places both in Gulf of Mannar and Palk Bay. Grass beds are excellent habitat for burrowing molluscs while their leaves and stems afford substratum and protection to epifaunal elements (Taylor & Lewis 1970). Among the epifauna of this area the bivalves are represented by *Gafrarium tumidum* and rarely *Circe scripta. Cyprea histrio, C. arabica, Murex virgineus* and *Cerithium scabridum* and *C. trailli* the last two being found on the leaves and stems of sea grass. Yet another common gastropod, *Pyrene* seen on the leaves and stems is represented by three species, *P. versicolor, P. vulpeula* and *P. flavida.* However, *Pyrene* is more abundant on various algae (*vide infra*). During January-February young ones of *Trochus radiatus* and *T. stellatus* were seen on the leaves, the adults of which are common inhabitants of eulittoral hard substratum. *Neritina oualaniensis* is also found in Manauli Island. The opisthobranch *Dolabella rumphii* was found in fair numbers at Station 2 during January, 1974.

The molluscan fauna of the grass beds in this area is dominated by *Pinna bicolor,* and a variety of animals found attached on their shells. There is a very heavy concentration of *Pinna* at Station 2 which is near a sewage outlet. A similar situation in Seychelles, where sewage disposal encouraged the settlement of *Pinna* was recorded by Taylor (1968). The larger specimens in Gulf of Mannar measure 30 to 35 cm in shell length and as many as 15 are found per square metre at sites of high concentration. A few species of molluscs such as *Modiolus metcalfei* and *M. carvalhoi* among the bivalves and *Ischnochiton* among the Amphineura and *Neritina oualaniensis* among the gastropods are found attached on the shells of *Pinna.*

d. *Alga associated molluscs*: (Fig. 3)

Stations 3a, 7, 11a and 13.

The sublittoral algal communities afford a very suitable habitat for both young and adult molluscs. The common algae, searched for their molluscan macrofauna were *Sargassum, Turbinaria, Padina, Ulva, Caulerpa, Gracilaria, Gelidiella* and *Hypnea.* The molluscan assemblage associated with each of these is briefly presented below.

Ulva recticulata forms extensive green patches in the lagoon bottom of Palk Bay along Mandapam during July to October and is often found washed ashore in large quantities. (Pl. 2, Fig. 2). Many gastropods are found attached to this alga, such as *Catharidus interruptus, Thais tissoti, Cerithium scabridum, Drupa margiriticola,* and *Trochus radiatus* (very small ones 3 to 5 mm in diameter) and *Planispira fallaciosa.* Almost all the specimens collected were young ones, their adults being characteristic inhabitants of other substrata.

Caulerpa racemosa is common on the reefs and other isolated hard substrata. Many nudibranchs are reported to be associated with this alga, though our collection yielded none. The bivalve gastropod *Berthelinia limax* was found in fair numbers in Palk Bay. These animals have a brilliant green colour, perfectly

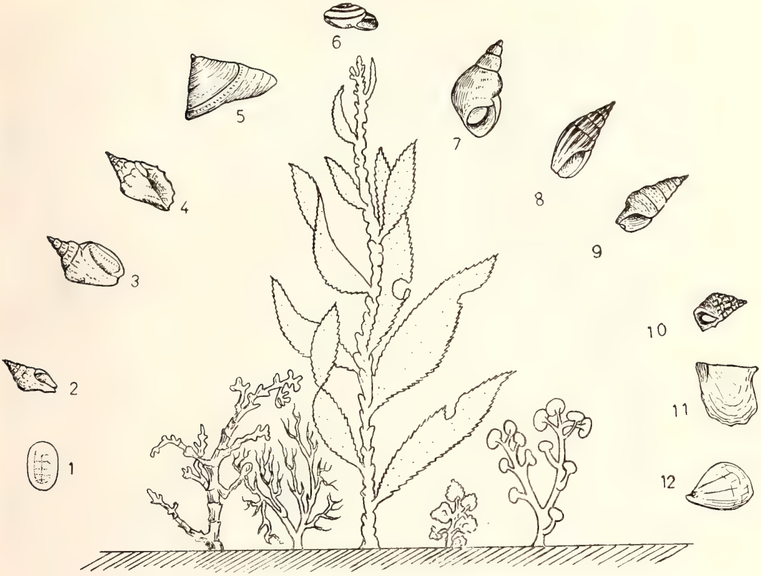


Fig. 3. A general representation of the molluscs associated with various algae. 1. *Ischinochiton* sp. × 2.5; 2. *Pyrine zebra* × 1.3; 3. *P. versicolor* × 1; 4. *Drupa margeriticola* × 1; 5. *Trochus stellatus* × 1; 6. *Planispira fallaciosa* × 1.5; 7. *Phasionella nivosa* × 1; 8. *Pyrine vulpecula* × 1; 9. *Cerithium scabridum* × 1; 10. *Nodilittorina pyramidalis* × 1; 11. *Pinctada anomoides* × 0.5; 12. *Berthelinia limax*.

matching that of the alga, and it is difficult to spot the animals in the field. There seems to be a sort of specificity in the association between *Berthelinia* and *Caulerpa* and we failed to collect this mollusc from any other algae we examined. It may be noted that the first Carribbean bivalve gastropod, *B. caribbea*, was also recorded on *Caulerpa* (Edmunds 1962).

Padina gymnospora is found on the reefs and in the lagoon. There is a preponderance of this at Station 3a from where we collected several samples during January, 1974. At least four species of gastropods, *viz. Drupa tuberculata, D. margiriticola, Pyrene zebra* and *Trochus radiatus* were found on the leaves along with *Ischnochiton* sp. Bivalves were not represented. *Padina* is a less favoured habitat for molluscs when compared to other higher algae from the same locality such as *Sargassum* and *Turbinaria*.

Turbinaria sp. grows in patches in several places and was found to be common at station 3a. The economically important small gastropod *Pyrene zebra* is common on the stems and leaves of this alga. *Drupa mangiriticola* and *D. tuberculata* also occur but in very few numbers. *Planispira fallaciosa* and *Phasionella nivosa* occur rarely. Juveniles of *Trochus radiatus* were found in January with plantigrades of the bivalve *Modiolus* sp. *Turbinaria ornata* from Palk Bay yielded *Pyrene versicolor* a species which we could not collect from *T. conoides*.

Two species of *Sargassum, viz. S. wighti* and *S. myriosystem* are common here. On the former *Pyrene zebra* and *P. versicolor* are very abundant. Juveniles of *Trochus radiatus* and plantigrades of *Pinctada anamoides* are also rarely seen. *Sargassum* growing on hard substrata seems to be the most ideal habitat for *Pyrene* in this area.

Yet another common alga in almost all localities of both Gulf of Mannar and Palk Bay is *Gracilaria edulis. G. edulis* yielded *Pyrene versicolor, P. zebra, Phasionella nivosa* and *Drupa margiriticola, Cantharidus undosus* and *Astrea semicostata* though none of the species is common. During December-January, juveniles of *Trochus* were common. All the molluscs found on *Gracilaria* were gastropods.

Two species of *Hypnea, viz. H. musciformis* and *H. valentiae,* were found to be common on the sandstone blocks under the Pamban Bridge. (Station 7). In January, it was found that all the samples contained several plantigrades of *Modiolus* in the size range of 2 to 5 mm. Very rarely juveniles of pearl oysters were also seen. Juveniles of *Trochus, Cellana* and *Ischnochiton* were also collected. However, the commonest and most abundant molluscs associated with *Hypnea* during January was *Modiolus*.

A notable feature of the alga-associated molluscs of this area during the December-February period was the presence of a large number of juveniles of both gastropods and bivalves. These include those of *Trochus, Cellana, Cerithium, Cantharus* and *Pyrene* among the gastropods, and of *Pinctada* and *Modiolus* among the bivalves. There exists a constant association between the developing stages of some bivalves such as *Mytilus edulis* and various filamentous algae (Colman 1940; Chipperfield 1953; Bayne 1964). It has been shown that mussels rarely settle on existing beds of adults, probably to avoid competition. The juveniles get attached and detached more than once on filamentous substrates before they finally get settled. The presence of juveniles of various molluscs on different algae indicates that there is no strict specificity during their primary settlement to any alga, all available filamentous substrata being utilised. The presence of juveniles during the December-January period is again an indication to the breeding period of these molluscs here coinciding with those of littorinids.

Coral-associated molluscs:

Corals afford a substrate for several types of animals, providing food and shelter. Mention has already been made of the molluscs associated with the reef flat and dead boulders. In the living corals, the branching forms provide loose interspace where many animals including molluscs can live free from the attack of predators. Massive corals provide attachment surface as well as penetrable substratum for boring animals (Morton and Challis 1969). The reef associated animals can be broadly divided into: *Hypobion*—those concealed in the shade or under the substratum: the *parabion*—composed of those animals living on the lighted reaches of living corals; and *epibion*—constituting those living on recently dead corals or algae. A fourth group is *cryptobion* composed of burrowing forms or those which live in the burrows of other animals (Morton and Challis 1969). Taylor (1971a) categorises reef-associated molluscs into those that use corals as a convenient substrate for protection and the others that actually feed on coral polyps.

The structure of the living reef and the zonation of corals in this area have been already discussed by Pillai (1971a, 1971b) and Mergner & Scheer (1974). Though zonation on the fringing reef is indistinct, we recognise here an *Acropora* community to include ramose corals, a *Porites* community to designate massive corals dominated by *Porites* spp., and an *Echinopora* community to incorporate foliaceous corals such as *Echinopora* and *Montipora foliosa.*

The major components of the *Acropora* community are *Pocillopora damicornis, Montipora divaricata, Acropora formosa, A. corymbosa, A. hyacinthus, A. millepora, A. nobilis,* and *A. humilis. A. millepora* and *A. nobilis* are more common on the Gulf of Mannar reefs while *A. corymbosa* is abundant on the Palk Bay side. *P. damicornis* is omnipresent. Most of these small-polyped ramose corals establish themselves at the outer side of the reef where water is clearer and deeper (Pillai 1971a).

The branching corals seem to be favoured by many gastropods where they seek protection in the interspaces of branches and undersides. We could not collect any coral-eating molluscs. *Pyrene versicolor, Drupa* spp. and *Cerithium* spp. are common among the branches of *Acropora millepora* and *A. corymbosa. Trochus* spp. were found on the dead upper regions and bases of several colonies. *A. millepora* from Manauli Island yielded *Spondylus layardi. A. formosa* and *A. nobilis* with their arborescent coralla are less favoured habitats than the corymbose forms probably due to non-availability of closely placed branches that afford protection. On the dead parts of all ramose corals, *Crassostrea cucullata, Arca* spp., *Isognomon isognomon, Pinctada* and *Lithophaga* spp. were seen.

Porites community (Fig. 4) forms the basic structure of the reefs in this area. *P. solida, P. lutea.* and *P. somaliensis* are fairly common both in the living and semifossilised condition. Among and on *Porites* are seen *Favia favus, Favites abdita, Favia pallida, Leptastrea* spp., *Cyphastrea* spp., *Platygyra lamellina* etc. (see Pillai, 1972 for the list of corals from this area).

Both gastropods and bivalves are found on the massive corals. A few gastropods such as *Drupa margiriticola, Pyrene* spp. and *Cerithium* spp., were found crawling on the surface of massive corals. *D. margariticola* is abundant on the Palk Bay and a large number of them get into the traps set by the local fishermen for catching reef fishes. *Astrea semicostata* and *Planispira fallaciosa* are also seen. *Lambis lambis* is found between the massive coral heads, sometimes in the sandy areas; sometimes the living molluscs afforded substratum to small colonies of *Porites* or *Siderastrea,* the corals thus getting free transport. Among the bivalves attached to the surface and undersides of massive corals were *Arca* spp., *Isognomon, Pinctada* and *Crassostrea.* However, the intensity of surface living bivalves was more on the dead coral shingle than on the living corals.

The dead, and rarely living corals, harbour a rich and varied fauna of burrowing bivalves (Appukuttan 1972). The mytilids are by far the commonest. *Lithophaga* is represented by at least five species, *viz. L. nigra, L. gracilis, L. teres, L. stramineus* and *L. levigata; L. nigra* being the commonest. The lithophaga make deep burrows generally double the length of their shells. *Botulla cinnamonea* makes shallow burrows. The venerid bivalves *Venerupis macrophyllia* and the petricolid,

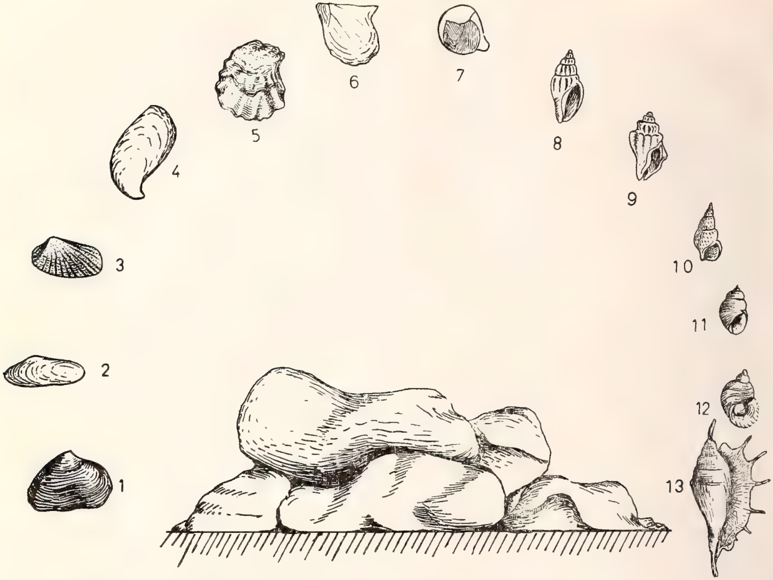


Fig. 4. A general representation of the molluscs a associated with massive corals. 1. *Venerupis macrophyllia* × 0.5; 2. *Lithophaga* spp.; 3. *Arca* spp. 4. *Isognomon isognomon* × 0.5; 5. *Crassostrea cucullata* × 0.5; 6. *Pinctada anomoides* × 1; 7. *Jouannetia cumingii* × 0.5; 8. *Pyrine* spp.; 9. *Drupa margeriticola* × 0.5; 10. *Cerithium trailli* × 0.5; 11. *Nodilittorina leucostica* × 1; 12. *Turbo intercostalis* × 1; 13. *Lambis lambis* × 0.5.

Petricola lithophaga and *P. divergence,* are also common in shallow burrows. *Aloides sulculosa, Gastrochaenia, Pholadides, Jouannetia, Parapholas* and *Clavagella* are the other common burrowing bivalves of this area [For others see Table 1, a detailed account of which has been already published by Appukuttan (1972)]. Though most of the burrowing forms are found in the dead parts of the corals, rarely *L. gracilis* was collected from the living parts of *Porites solida* and *Favia pallida.*

DISCUSSION

Species diversity and percentage composition

The percentage composition of the main molluscan groups in the collections from each habitat is presented in Table 2. The entire molluscan fauna found on the mangroves belongs to Gastropoda. Adult gastropods were more on the eulittoral boulders than bivalves, while the submerged shingle has the maximum (85%) concentration of surface living bivalves. The maximum number of species was found in massive corals (38) of which 26 were bivalves, 18 of them being boring forms and the rest surface living. The mollusca of the littoral fringe was composed entirely of gastropods, while the eulittoral zone had 3.75% Amphineura, 68.5% gastropods and 27.75% bivalves. In the sublittoral molluscan fauna, Amphineura constitute 1.3%, gastropoda 38.7% and bivalves 60%.

Taylor (1971b) has attributed increased diversity of species in the sublittoral zone at Aldabra to tolerance of species to emersion. According to him (p. 206) this factor will account for the reduced diversity of species on higher shores. Those few species capable of inhabiting higher zones will exploit the available habitat resulting in a high density of population. In essence, the organisms of the intertidal zone are predominantly physically regulated communities and their major adaptations are of a physical nature, since the environment is subjected to varying physical factors. In the lower level (sublittoral) the animal communities are biologically controlled since the environment is mostly uniform. The biological inter-reaction result in a greater diversity of species (Sanders 1968). In such a situation the density of individuals of various species may not be as high as on the higher levels.

Factors Influencing the Distribution of Molluscs in Different Substrates

1) *Adaptation to physical conditions*:

Temperature tolerance and ability to withstand desiccation is the largest single factor that restricts the distribution of many intertidal animals. Smith and Newell (1955) have shown that the initial settlement of periwinkles takes place on a lower level, the upper tidal levels being later colonised by adults. A similar phenomenon is shown here by *Nodilittorina pyramidalis* on sandstone. *Planaxis sulcatus* and *Cerithium trailli* occupy different levels, the former always being at a higher level at Mandapam. Ability to restrict the loss of water during exposure and the thickness of shell are major adaptations for a successful life on intertidal areas. Among the *Planaxis* and *Cerithium trailli* collected from the same station there was a notable variation in their fresh flesh and shell weight ratio. The ratios of flesh weight to shell weight in *Planaxis* and *C. trailli* were 1:7.2 and 1:5.8 respectively as calculated from 50 specimens from random samples. This clearly indicates a higher ratio in shell weight to that of flesh in *Planaxis* which will probably account for its ability to occupy a higher position in the vertical range of zonation, than *C. trailli*.

ii) *Feeding relationship and distribution*:

Availability of food is a major factor that influences the distribution of animals. The concentration of *Pinna bicolor* among the seagrass beds is correlated with the availability of rich food from the plant material found in the sediments around (Taylor & Lewis 1970). The preponderance of *Pinna* near the site of sewage disposals lends further support to the view that supply of food for these filter feeders immensely influences their abundance. The presence of *Thias* (*Purpurea*) *rudolphi* and *Drupa margariticola* also appears to be correlated with their carnivorous feeding relationships. *Thias* feeds on *Cellana, Gafrarium* and other gastropod found on the upper zone of the eulittoral. *Polinices mamilla* and other gastropod found on the eulittoral zone feed on bivalves found on the same zone. The mangrove associated *Littorina scabra* are able to feed on mangrove vegetation. The occurrence of large populations of *Planaxis* and

TABLE 1

LIST OF MOLLUSCS COLLECTED FROM DIFFERENT HABITATS WITH THEIR RELATIVE ABUNDANCE

No.	Name of species	Raised reef	Sand-stone	Eulittoral boulders	Submerged Shingle	Unvegetated sand	Sea grass	Algae	Mangrove	Reef crest	Corals Massive	Corals Branching
		1	2	3	4	5	6	7	8	9	10	11
	Class Amphineura											
1.	*Craspidochiton* sp.	–	P	–	–	–	–	–	–	–	–	–
2.	*Ischnochiton* sp.	–	–	C	–	–	–	–	–	–	–	–
3.	*Emarginula obovata*	–	–	R	–	–	–	–	–	–	–	–
	Class Gastropoda											
4.	*Cellana radiata*	–	P	P	–	–	–	–	–	–	–	–
5.	*Stomatella* sp.	–	–	R	–	–	–	–	–	–	–	–
6.	*Cantharidus interruptus*	–	–	–	–	–	–	R	–	–	–	–
7.	*Trochus radiatus*	–	P	P	–	–	R	P	–	P	P	–
8.	*T. stellatus*	–	–	–	–	–	R	–	–	–	P	R
9.	*Turbo intercostalis*	–	–	P	–	–	–	R	–	P	P	R
10.	*Astrea semicostata*	–	–	–	–	R	–	R	–	R	R	–
11.	*Phasionella nivosa*	–	–	–	–	–	–	P	–	–	–	–
12.	*Nerita maura*	–	–	P	–	–	–	–	–	R	–	–
13.	*N. albicilla*	–	–	R	–	–	–	–	–	–	–	–
14.	*N. chameleon*	–	–	R	–	–	–	–	–	–	–	–
15.	*N. plicata*	–	R	–	–	–	–	–	–	–	–	–
16.	*Neritina oualaniensis*	–	–	–	–	R	R	–	–	–	–	–
17.	*Littorina kraussi*	–	R	–	–	–	–	–	–	–	–	–
18.	*L. melanostoma*	–	–	–	–	–	–	–	R	–	–	–
19.	*L. scabra*	–	–	–	–	–	–	–	P	–	–	–
20.	*L. undulata*	P	C	R	–	–	–	–	–	–	–	–
21.	*Nodilittorina leucostica*	–	C	–	–	–	–	–	–	–	R	–
22.	*N. pyramidalis*	P	C	–	–	–	–	R	–	–	R	–
23.	*Cerithidea fluviatilis*	–	–	–	–	C	–	–	P	–	–	–
24.	*Planaxis sulcatus*	P	–	C	–	–	–	–	P	–	–	–
25.	*Cerithium citrinum*	–	–	–	–	–	–	–	–	–	–	R
26.	*C. trailli*	–	–	C	P	P	R	–	–	P	P	–
27.	*C. obeliscus*	–	–	P	–	P	–	–	–	–	–	–
28.	*C. scabridum*	–	–	–	–	P	R	P	–	–	–	R
29.	*Lambis lambis*	–	–	–	–	–	–	–	–	–	R	R
30.	*Polynices mamilla*	–	–	–	–	R	–	–	–	–	–	–
31.	*Cyprea arabica*	–	–	P	–	–	–	–	–	R	–	–
32.	*C. caputserpentis*	–	–	P	–	–	–	–	–	P	–	–

33.	*C. histrio*	–	–	R	–	–	–	–	–	–	–	–
34.	*C. moneta*	–	–	P	–	–	–	–	–	P	–	–
35.	*Bursa spinosa*	–	–	–	–	R	–	–	–	–	–	–
36.	*Murex virgeneus*	–	–	R	–	–	R	–	–	–	–	R
37.	*M. trapa*	–	–	–	–	R	–	–	–	–	–	–
38.	*Drupa horrida*	–	–	–	–	–	–	R	–	R	–	–
39.	*D. margiriticola*	–	R	P	P	P	–	P	–	C	C	C
40.	*D. tuberculata*	–	–	–	–	–	–	R	–	R	–	P
41.	*Thias (Purpurea) rudolphi*	–	P	P	–	R	–	–	–	P	–	–
42.	*Thias carnifera*	–	R	R	–	–	–	–	–	–	–	–
43.	*T. tissoti*	–	–	–	–	–	–	R	–	–	–	–
44.	*Pyrene flavida*	–	–	–	–	–	R	–	–	–	–	–
45.	*P. versicolar*	–	–	–	–	–	P	C	–	P	P	C
46.	*P. vulpecula*	–	–	–	–	–	R	R	–	–	–	–
47.	*P. zebra*	–	–	–	–	–	–	C	–	C	–	C
48.	*Cantharus undosus*	–	–	–	–	–	–	R	–	P	–	–
49.	*Nassa thersites*	–	–	–	–	R	–	–	–	–	–	–
50.	*Marginella anguistata*	–	–	R	–	–	–	–	–	–	–	–
51.	*Conus amadis*	–	–	R	–	–	–	–	–	–	–	–
52.	*C. coronatus*	–	–	R	–	–	–	–	–	–	–	–
53.	*Haminoea* sp.	–	–	R	–	R	–	–	–	–	–	–
54.	*Aplysia lineolata*	–	–	P	–	–	–	–	–	–	–	–
55.	*Dolabella rumphii*	–	–	–	–	R	P	–	–	–	–	–
56.	*Berthelinia limax*	–	–	–	–	–	–	P	–	–	–	–
57.	*Cassidula* sp.	–	–	–	–	–	–	–	R	–	–	–
58.	*Onchidium verruculatum*	–	P	C	–	–	–	–	–	–	–	–
59.	*Planispira fallaciosa*	–	–	–	–	–	–	R	–	–	–	R
60.	*P. vittata*	–	–	–	–	–	–	–	–	–	R	–
	Class Bivalvia											
61.	*Arca avellana*	–	–	–	P	–	–	–	–	–	–	–
62.	*C. complanata*	–	–	–	C	–	–	–	–	–	–	–
63.	*A. fusca*	–	–	–	–	–	–	–	–	P	C	P
64.	*A. symmetrica*	–	–	–	P	–	–	–	–	–	C	–
65.	*Modiolus carvalhoe*	–	–	–	–	–	R	–	–	–	–	–
66.	*M. metcalfei*	–	–	–	–	–	P	–	–	–	–	–
67.	*Modiolus* sp.	–	–	–	–	–	–	C	–	–	–	–
68.	*Lithophaga gracilis*	–	–	–	–	–	–	–	–	–	C	R
69.	*L. levigata*	–	–	–	–	–	–	–	–	–	P	–
70.	*L. nigra*	–	R	–	–	–	–	–	–	–	P	P
71.	*L. stramineus*	–	–	–	–	–	–	–	–	–	P	R
72.	*L. teres*	R	–	–	–	–	–	–	–	–	P	R

73.	*Botula cinnamonea*	–	–	–	–	–	–	–	–	–	P	–
74.	*Isognomon isognomon*	–	–	–	C	–	–	–	–	–	P	P
75.	*I. legumen*	–	–	–	–	–	–	–	–	–	R	–
76.	*I. nucleus*	–	–	–	P	–	–	–	–	–	–	–
77.	*Vulsella vulsella*	–	–	–	P	–	–	–	–	–	–	–
78.	*Pinctada anomoides*	–	–	–	P	–	–	–	–	–	R	R
79.	*P. margaritifera*	–	–	–	R	–	–	R	–	R	R	R
80.	*Pinna bicolor*	–	–	–	–	R	C	–	–	–	–	–
81.	*Spondylus layardi*	–	–	–	–	–	–	–	–	–	–	R
82.	*Spondylus* sp.	–	–	–	–	–	–	–	–	–	R	–
83.	*Crassostrea cucullata*	–	P	P	–	–	–	–	–	P	P	P
84.	*Lucina edentula*	–	–	–	–	–	P	–	–	–	–	–
85.	*Codakia angela*	–	–	–	–	–	P	–	–	–	–	–
86.	*Galeoma paucistriata*	–	–	–	P	–	–	–	–	–	–	–
87.	*Scintilla hanleyi*	–	–	–	P	–	–	–	–	–	–	–
88.	*S. timorensis*	–	–	–	R	–	–	–	–	–	–	–
89.	*Gafrarium dispar*	–	–	R	–	–	–	–	–	–	–	–
90.	*G. divaricata*	–	–	R	–	–	–	–	–	–	–	–
91.	*G. pectinatum*	–	–	R	R	–	–	–	–	–	–	–
92.	*G. tumidum*	–	–	P	–	P	P	–	–	–	–	–
93.	*Circe scripta*	–	–	–	–	–	R	–	–	–	–	–
94.	*Dosinia cretacea*	–	–	–	–	R	–	–	–	–	–	–
95.	*Dosinia* sp.	–	–	–	–	–	R	–	–	–	–	–
96.	*Venerupis macrophyllia* ..	P	–	–	–	–	–	–	–	R	R	R
97.	*Petriocola divergens*	P	–	–	–	–	–	–	–	P	P	–
98.	*P. lithophaga*	–	–	–	–	–	–	–	–	–	P	–
99.	*Mesodesma trigona*	–	–	–	–	R	–	–	–	–	–	–
100.	*Atactodea glabrata*	–	–	–	–	P	–	–	–	–	–	–
101.	*Mactra cuneata*	–	–	–	–	P	–	–	–	–	–	–
102.	*Donax cuneatus*	–	–	–	–	P	–	–	–	–	–	–
103.	*D. faba*	–	–	–	–	C	–	–	–	–	–	–
104.	*Aloides sulculosa*	–	–	–	–	–	–	–	–	–	P	P
105.	*Gastrochaena apertissima*	–	–	–	–	–	–	–	–	–	P	P
106.	*G. gigantea*	R	–	–	–	–	–	–	–	–	P	P
107.	*G. impressa*	R	–	–	–	–	–	–	–	–	P	P
108.	*Pholadidea cheveyi*	–	–	–	–	–	–	–	–	–	P	–
109.	*Parapholas quadrizonata*	P	–	–	–	–	–	–	–	–	P	–
110.	*Diplothyra* sp.	R	–	–	–	–	–	–	–	–	P	–
111.	*Jouannetia cumingii*	P	–	–	–	–	–	–	–	–	P	–
112.	*Clavagella lata*	–	–	–	–	–	–	–	–	–	R	–

P = Present; C = Common; R = Rare.

TABLE 2

THE TOTAL NUMBER OF SPECIES OF MOLLUSCS COLLECTED AT EACH HABITAT WITH THE PERCENTAGE REPRESENTATION OF DIFFERENT CLASSES

Habitat	Total No. of species	Percentage composition		
		Amphineura	Gastropoda	Bivalvia
Raised Reef	14	8	25	67
Sandstones	14	7	79	14
Eulittoral boulders	32	6	78	16
Submerged shingle	13	nil	15	85
Unvegetated sand	22	nil	63	37
Seagrass	19	5	52	43
Algae	21	5	85	10
Mangrove	5	nil	100	nil
Reef flat	21	5	71	24
Massive corals	38	2.5	28.5	69
Branching corals	26	nil	43	57

Cerithium on the eulittoral boulders in Palk Bay is also associated with the presence of algae like *Chaetomorpha* and *Euteromorpha* on which these gastropods feed (Rao & Sundaram 1972).

iii) *Protection*:

Many molluscs select a substratum free from predators and wave action. Several gastropods live among the branches of ramose corals and algae. Wieser (1952) pointed out that the principal factor controlling the nature and abundance of organisms of intertidal seaweeds is the growth form of the species of seaweed. Variations in the density of gastropod population on different algae have been discussed earlier. Boring bivalves are typical examples of marine animals on penetrable substrates like corals and wood. Some molluscs have cryptic colours for protection. *Berthelinis limax* on *Caulerpa* is a classic example in this regard.

iv) *Larval behaviour*:

The presence of juveniles of eulittoral gastropods on sublittoral algae may be due to a larval adaptation. The larvae or juveniles are unable to thrive or are less successful on the more exposed conditions subjected to much physical changes and hence first get settled on lower levels and later migrate to their ultimate ecological niches. This will also avoid competition for food from the adults. The primary settlement of mytilid larvae on filamentous substrate away from the adult beds has already been discussed. This will also help the dispersal of young ones to an extent. The occurrence of juveniles of *Trochus, Cellana* and *Nodilittorina* on sublittoral algae may be a larval adaptation to more favoured habitats than their adults normally live on.

SUMMARY

The eulittoral, and littoral fringe sandstones of this area show a clear vertical range of zonation by different gastropods, correlated with the conditions of wave action, exposure,

desiccation, temperature and availability of food.

There is a preponderance of gastropods on the littoral fringe and eulittoral hard substrates while the submerged hard bottom supports mostly bivalves. Wherever gastropods are plenty, bivalves are of little significance, and *vice versa.*

The molluscan fauna of the seagrass community is dominated by *Pinna bicolor*. At the sites of waste sewage disposal, the density of population is very high.

Beach-clams are represented by *Donax* and *Atactodea*. The former is very common along the mainland coast while the latter occurs on the island shores.

No species of molluscs exists in large quantities though *Cerithium, Cerithidea, Drupa, Thias* and *Planaxis* are common in the intertidal zones. The commercially important gestropod, *Pyrene* spp., occurs in large numbers on reefs and higher algae. Among the bivalves *Pinna, Gafrarium, Donax, Grassostrea* and *Arca* are very common. Recently there is a settlement of pearl oysters at the bottom boulders of Palk Bay lagoon along Mandapam.

The presence of juveniles and spat of several molluscs during the onset of northeast monsoon indicates that most of the common molluscs of this area breed towards the close of southwest monsoon.

The young ones often choose a safer or more protected environment different from the ecological niche at which the adults ultimately settle.

Quarrying of corals for industrial purposes, resulting in the destruction of the reefs in several places around Mandapam, has caused the dwindling of the reef associated molluscs. This was ascertained by a comparative study of the fauna of disturbed and undisturbed reef tracts.

The major factors that limit the distribution and abundance of various species in different habitats are—nature of bottom, wave action, exposure, temperature, availability of suitable food, and behavioural aspects of larvae and adults.

The qualitative abundance of common molluscs in different habitats is discussed. Numerical assessment of individuals of some common species was made by analysing sample plots.

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REFERENCES

ALAGARSWAMI, K. (1968): Studies on some aspects of the Wedge-Clam, *Donax faba* Gmelin from Mandapam coast in the Gulf of Mannar. *J. Mar. biol. Ass. India, 8*(1): 56-75.

APPUKUTTAN, K. K. (1972): Coral-boring Bivalves of Gulf of Mannar and Palk Bay. *Proc. Symp. Corals and Coral reefs, 1969. Mar. biol. ass. India*: 379-398.

ARUDPRAGASAM, K. D. (1970): Zonation on two shores on the west coast of Ceylon. *J. Mar. biol. Ass. India, 12*(1): 1-14.

ATAPATTU, D. H. (1969): Distribution, movement and behaviour of *Nodilittorina granularis* (Gray) on a shore at Negombo, Ceylon. *Proc. Symp. Mollusca, 1968. Mar. biol. Ass. India,* Pt. II: 513-518.

BAYNE, B. L. (1964): Primary and secondary settlement in *Mytilis edulis* (Mollusca). *J. Anim. Ecology, 33*(3): 513-526.

CHIPPERFIELD, P. N. J. (1953): Observations on the breeding and settlement of *Mytilus edulis* (L.) in British waters. *J. Mar. Biol. Ass. U.K., 32*: 449-476.

COLMAN, J. (1940): On faunas inhabiting intertidal seaweeds. ibid., *24*: 129-183.

COOMAN, H. E. (1969): Biological aspects of mangrove mollusks in the West Indies. *Malacologia, 9*(1): 79-84.

EDMUNDS, M. (1962): Bivalved gastropods from Jamaica. *Nature* (*Lond.*), *195*(4839): 402.

FOOTE, R. B. (1889): Notes on Rameswaram Island-I. *Madras Christian College Mag.*, July, 1888: 828-840.

GRAVELY, F. H. (1927): Littoral fauna of Krusadai Island. Mollusca. *Bull. Madras Govt. Mus.* (Nat. Hist.) *new ser.,* I(1).

HORNELL, J. (1915): The Indian varieties and races of *Turbinella. Mem. Indian. Mus.* Calcutta, *6*: 109-122.

——————— (1917): The edible molluscs of the Madras Presidency. *Madras Fish. Bull. 11*: 1-51.

——————— (1922): The common molluscs of south India. ibid., *14*: 97-215.

——————— (1951): Indian molluscs. Bombay Natural History Society, 1-96.

JONES, S. (1970): The molluscan fishery resources of India. *Proc. Symp. Mollusca. Mar. Biol. Ass. India,* pt. 3: 906-918.

LEWIS, J. R. (1955): The mode of occurrence of the universal intertidal zones in Great Britain. *J. Ecology,* 43: 270-290.

——————— (1961): The littoral zone on rocky shores—a biological or physical entity? *Oikos,* 12: 280-301.

——————— (1972): The Ecology of the Rocky shores. The English University Press: 1-323.

MACNAE, W. (1968): A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific region. *Adv. mar. Biol. 6*: 73-270. Academic Press, London.

MACNAE, W. & KALK, M. (1962): The ecology of the mangrove swamps at Inhaca Island, Mocambique. *J. Ecol., 50*(1): 19-34.

MORTON, J. E. & CHALLIS, D. A. (1969): The biomorphology of Solomon Islands shores with a discussion of zoning patterns and ecological terminology. *Phil. Trans. R. Soc. Lond., ser.* B, *255*: 459-516.

NAIR, R. V. & RAO, K. S. (*Ed.*) (1974): The commercial molluscs of India. *Bull. Cent. mar. Fish. Res. Inst., 25*: 1-170.

NEWELL, R. C. (1969): Adaptations to temperature fluctuations in intertidal animals. *Amer. Zool., 9*: 293-307.

——————— (1970): Biology of intertidal animals. 1-555. Logos Press, London.

PILLAI, C. S. GOPINADHA (1971a): The distribution of corals on a reef at Mandapam, Palk Bay. *J. mar. biol. Ass. India, 11* (1 & 2): 62-72.

——————— (1971b): Composition of the coral fauna of the southeastern coast of India and the Laccadives. In *Regional variation in Indian Ocean coral reefs. Symp. Zool. Soc., London, 28*: 301-327.

——————— (1972): Stony corals of the seas around India. *Proc. Symp. Corals and Coral Reefs. Mar. biol. ass. India*: 191-216.

——————— (1975): An assessment of the effect of environment and human interference on the coral reefs of Palk Bay and Gulf of Mannar along the Indian coast. *Seafood Export J., 7*(12): 1-13.

RAO, K. SATYANARAYANA & SUNDARAM, K. S. (1972): Ecology of intertidal molluscs of Gulf of Mannar and Palk Bay. *Proc. National Acad. Science, 38*: pt. B: 462-474.

RAO, M. UMAMAHESWARA (1972): Coral reef flora of the Gulf of Mannar and Palk Bay. *Proc. Symp. Corals and Coral Reefs. Mar. Biol. ass.*

India: 217-230.

Rao, K. Virabhadra (1970): Pearl Oysters of the Indian region. *Proc. Symp. Mollusca. Mar. biol. Ass.* India, pt. 3: 1017-1028.

Reddiah, K. (1972): The Appa Island and its fringing reef in the Gulf of Mannar. *J. mar. biol. Ass. India, 12*(1 & 2): 57-63.

Sanders, H. L. (1868): Marine benthic diversity: a comparative study. *Am. Nat., 102*: 243-282.

Satyamurthi, S. T. (1952): The mollusca of Krusadai Island (in the Gulf of Mannar). I. Amphineura and Gastropoda. *Bull. Madras Govt. Mus.*, (*new ser.*) *1*(2): part 6: 1-265.

———— (1956): The mollusca of Krusadai Island (in the Gulf of Mannar): II. Scaphopoda, Pelecypoda and Cephalopoda. ibid. *1*(2): part 7: 1-202.

Sewell, R. B. S. (1935): Studies on corals and coral formations in Indian waters. *Mem. Asiatic. Soc.*, Bengal, *9*: 461-540.

Silas, E. G. (1968): Cephalopoda of the west coast of India collected during the Cruises of the Research Vessel "VARUNA" with a catalogue of the species known from the Indian Ocean. *Proc. Symp. Mollusca. Mar. biol. Ass. India,* part 1: 277-359.

Smith, J. E. & Newell, G. E. (1955): The dynamics of the zonation of the common Periwinkle [*Littorina littorea* (L.)] on a stony beach. *J. anim. Ecol., 24*(1): 35-56.

Stoddart, D. R. & Fosberg, F. R. (1972): South Indian Sandcays. *Atoll. Res. Bull., 161*: 1-16.

Stoddart, D. R. & Pillai, C. S. Gopinadha (1972): Raised reefs of Mamanathapuram, South India. *Trans. Inst. British Georgr., 56*: 111-125.

Taylor, J. D. (1968): Coral reefs and associated invertebrate communities (mainly molluscs) around Mahe Seychelles. *Phil. Trans. R. Soc.* (B) *254*: 129-206.

———— (1971a): Reef associated molluscan assemblages in the Western Indian Ocean. In Regional variation in Indian Ocean coral reefs. *Symp. Zool. Soc., London, 28*: 501-534.

———— (1971b): Intertidal zonation at Aldabra Atoll. *Phil. Trans. R. Soc. Lond.,* ser. B, 260: 173-213.

Taylor, J. D. & Lewis, M. S. (1970): The flora, fauna and sediments of the marine grass beds of Mahe Seychelles, *J. Nat. Hist., 4*: 199-220.

Wieser, W. (1952): Investigations on the microfauna inhabiting seaweeds on rocky coasts. IV. Studies on the vertical distribution of the fauna inhabiting seaweeds below the Plymouth Laboratory. *J. mar. biol. Ass. U.K., 31*: 145-174.

A MARCH BIRD COUNT IN POONA[1]

PRAKASH GOLE[2]

How many birds are there in an Indian city? To arrive at an estimate of the bird population of the city, a group of twenty bird-watchers from Poona decided to pool their energies to make a bird-count. The city was divided into sectors and a pair or group of bird-watchers was allotted one sector to make notes and count species and individuals. All birds that could be seen and heard (and definitely identified) while moving along the streets and lanes were counted. There are certain groups of trees in the city and on its river-banks which are favoured by birds for roosting. Counts of common Indian mynah, house and jungle crow, cattle and little egrets and pond herons where chiefly made at these places.

It was not possible to cover the city area in one day. Sectors had to be divided into sub-sectors. Each sub-sector was visited once to avoid double counting. Of course, a certain percentage of double counting is unavoidable as birds are highly mobile. However, care was taken to avoid it, mainly by restricting the count of such mobile birds as crows and mynahs to their roosting sites only. The total effort was spread over the duration of a week —the first week of March 1979.

During the week 130 bird-species were noted with a total population of more than 22,000 individuals. The count was spread over about 12,120 hectares or about 30,000 acres. The area includes the main wards of the city and the cantonment but excludes suburban areas such as Kirkee, Yerawada, Ghorpadi, Katraj, Hingne and some other small areas on the periphery. Out of the total area included in the bird-count about 60% was more or less fully covered, 24% partially covered, while over about 16% of the area observations were poor. Our coverage of garden birds was poor for obvious reasons. We could not enter private gardens and had to restrict counting to public parks and gardens only.

The total of about 22,000 birds counted gives a figure of less than one bird per acre or 1.8 birds per hectare. The actual number of birds per hectare is probably greater. As already pointed out, our coverage of garden birds was poor. Even if the number of garden birds is increased by 100 p.c., we will still be erring on the safe side. Our coverage of water-birds and birds of grasslands and fields, is better, believed to be around 60 p.c. This also includes common birds like house sparrow, house and jungle crow and common mynah. A 40 p.c. increase in the number of all these birds may not probably be out of proportion. These adjustments give us a total of about 32000 birds, i.e. 1.06 birds per acre or 2.6 birds per hectare. Comparable figures for other Indian cities are not available. However, for Inner London area a density of 0.9 to 1.75 breeding pairs per acre, has been given by Murton (Murton R. K. MAN & BIRDS, 1971).

It must be made clear that the figure includes migratory birds, both local and conti-

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[2] 277 Sindh Housing Society, Poona-411 007, (M.S.).

nental. A count taken in June and July will probably show a lower density as most of the migratory birds will have left by then. However, these migrants spend almost eight months of the year (September to April) in our land and there is no reason why we should exclude them while estimating the bird population of a particular area.

Admittedly, the count was weighted in favour of birds which are commensals of man namely house sparrow and crow, mynah and parakeet, pariah kite and blue rock pigeon. In Murton's figures also 88 p.c. of the breeding birds are feral pigeons and house sparrows. Here, the common Indian mynah formed almost a third of the total number of individuals. The mynah outnumbered the crow and the sparrow by almost 2 to 1. Not all the mynahs forage within the city however. They are commuters, flying out every morning to fields and grasslands to feed and flying in to roost each evening. We were surprised to find the number of house sparrows so low (1600). Probably these drab-coloured birds failed to attract our attention. Big flocks of sparrows were seen mainly in the evening when numbers collected and flew to roost. One roosting tree near the railway station attracted more than 500 of them.

Even crows were found to be more numerous than the house sparrow. About 2500 of them were counted. It was not always possible to distinguish between a house and a jungle crow, as counts were made mainly in the evenings. We suspect however, that there are as many jungle crows as there are house crows.

Early in the morning crows appeared to be the first to wake up and move about; while in the evening they were preceded by the common mynah for roosting. They flew in to roost in flocks of 20-30 or gangs of 5-10, in a leisurely fashion, flying at about tree-top height. Sometimes they used to make a sudden stoop on to a tree on the way, the flying army arresting flight suddenly and diving down to alight on the tree to the accompaniment of much noise. After a pause they continued their flight. They also perched on adjacent buildings before settling on the roosting trees. Even after reaching these trees some took to wing, flew about, made a detour only to come back to settle on the trees.

The common mynah roosts were nothing short of spectacular. At one roost more than 4000 mynahs were counted. They flew in to roost in flocks of 2-4, 7-8, 20-30 and 30-50. Most of them flew at moderate heights, though some coming into city from the west over the hills flew higher. Before reaching the trees mynahs too collected first in a convenient sport, a hill-slope, a grassy patch on a river-bank, even a tall theatre-building. Here they made a pause of 15 to 30 minutes before flying in *en masse* into the trees to the accompaniment of a deafening cackle.

House and jungle crows were found to be associating with common mynahs on all the roosts; while at one roost near the river about 350 cattle and little egrets and 325 pond herons came to roost with the mynahs and crows. They however, occupied acacia trees while the latter roosted on the banyan, the peepul and the rain tree. Egrets came in flocks of 10 to 25 birds, flying along the course of the river, while pond herons came one by one. Brahminy mynahs have smaller roosts scattered all over the city. They do not associate with the common mynah but roost separately in groups of 5 to 50. Normally in the first fortnight of March every year, rosy pastors arrive and spend some days in the city. They also were seen to roost with the common mynah. 400 were counted at one roost alone.

While the mynah roosts are mostly in the central, southern and western parts of the city, the rose-ringed parakeet prefers chiefly the Koregaon Park area to the east. In the evening they were seen to fly energetically in groups of 20-40 birds to settle in large banyan and peepul trees. Smaller groups coalesced into larger ones as roosting trees drew near and they used to settle with an incessant chatter which normally went on with interruptions till late at night. They appear to be late-risers too, leaving the roost after sunrise when most of the other birds are up and about. More than 1000 parakeets roost there.

As in other Indian cities some pariah kites and whitebacked vultures are usually to be seen quartering the skies of Poona city. Kites were found to be numerous in the Cantonment area and in early mornings these handsome birds were very active, diving, swooping on the ground for tit-bits and squealing. Breeding season of these birds was on and on a busy thoroughfare a nest with a sitting bird could easily be seen on a peepul tree about 10 metres up from the street level. Most of the vultures scavenge near the bone-crushing plant located at south-east of the city. Compared to whitebacked vultures, the number of neophron vultures was insignificant.

Out of the 130 species counted, 35 may be called garden and woodland birds which including bulbuls, magpie and Indian robins, sunbird, barbet, warblers, flycatchers, tit, woodpecker, flowerpecker, koel, golden oriole, iora, grey hornbill, white-eye, little minivet, spotted owlet etc. 37 species belonged to grassland, scrub and fallow-land. These included drongo, shrikes, babblers, munias, quails, bushchats, pipits, larks, doves, bee-eater, hoopoe, Indian roller, yellow-wattled lapwing, crested bunting etc. Ten species of birds of prey were recorded. They included three eagle species, blackwinged and large Indian kite, kestrel, shikra, sparrow-hawk, redheaded merlin and marsh harrier.

Poona's river banks harbour a rich variety of bird-life; 110 species have so far been recorded in the Mula-Mutha Bird Sanctuary area alone. During the present count 39 species of water-birds were recorded. These included dabchick, kingfishers, wagtails, coots, terns, egrets, swallows, ducks like garganey teal and pintail, and a variety of waders such as black-winged stilt, sandpipers, green and redshanks, little ringed plover, little stint, jacanas etc.

Out of the 130 bird species, 90 species were resident birds and the remaining migratory. Of the latter 18 are known to breed within Indian limits, but migrate either locally from the north or from the Himalayas. These included Indian Roller, collared bushchat, black-winged stilt, black redstart, blue rock thrush, lesser whistling teal etc. Species that habitually migrate over long distances numbered 22. They are winter visitors to our land and included ducks like garganey teal and pintail, wagtails, rosy pastors, desert wheatears etc.

What other peculiarities of bird-life could be noted during the count? As the breeding season was approaching songsters were slowly getting into form. Though the redvented bulbul and the magpie robin were not yet in full song, calls of iora and golden oriole could be heard. The koel was making feeble attempts to produce its characteristic call; the male would burst into his full song towards the end of the month. Surprisingly, a hawk-cuckoo was vocal in a park even though the weather was clear and sunny.

Pair-formation was still in its initial stages. The male magpie robin chased the female desultorily and without any fervour. The Indian robin had paired already but feeding of the female by the male could not yet be observed. The rufousbacked shrike uttered harsh notes from a tree or a telegraph cable as if proclaiming territorial rights but his mate was nowhere nearby. The purple sunbird was not yet in full breeding plumage and the male and the female foraged separately.

Cattle and little egrets and pond herons and pheasant-tailed jacanas were also not yet in breeding plumage. However, some dabchick pairs were busy constructing their floating nests near the far end of a reed-bed; while one pair of dabchick had already laid and was incubating a clutch of two eggs. On a steep bank even a small blue kingfisher was seen excavating a nest-hole.

Most of the migrants were still to be found in the city. The Indian redstart was still here though most would leave by the 10th. Blyth's reed and greenish leaf warblers could still be heard in the trees and in the morning the brilliant blossom of the silk cotton attracted hordes of chattering rosy pastors who would proceed north around 15th March. The blue rock thrush still lurked in the eaves of tall buildings and on hills and among boulders on the river bank. The Indian roller on the telegraph pole, the collared bush-chat on a bush-top, a bluethroat in a reed-bed and a lesser whitethroat skulking in bushes, was still a common sight. Some of the yellow wagtails had donned their distinctive dress and the greyheaded, the blueheaded and the blackheaded could be distinguished. Even some of the blackwinged stilts had put on their black caps, their restless flocks flying to and fro on the river. Most of the other waders appeared a shade brighter but still hunted singly or in flocks. Gatherings of common swallows hawked insects in the sky morning and evening though the number of redrumped swallows appeared to be surprisingly low. Moreover, there was a large influx of ducks, presumably returning from the south, in the Mula-Mutha Bird Sanctuary and the Pashan reservoir. The number of garganey teals had shot up from a hundred to over 500. Some pintails and redcrested pochards could also be seen among them. At this time and at this time only, a flock of lesser whistling teals visits Pashan reservoir every year. It was dutifully there this year also.

On the outskirts of the city, song of the redwinged bushlark and the Indian skylark was increasingly evident. On barren patches pairs of yellow-wattled lapwing could be seen silently creeping away from the observer. Here they will lay in the first week of April. Flocks of spotted and red munias gathered seeds quietly in grassland and along dusty tracks and baya flocks zoomed from tree to tree as if in search of a suitable nesting place.

A short-toed eagle, a few blackwinged kites and an occasional tawny eagle are usually to be seen on the periphery of the city. The great army of tawny eagles that at one time patronised the garbage dump is now no longer there. A large Indian kite, a booted eagle and a few marsh harriers were recorded on the river and reservoirs, while a kestrel, a shikra and a sparrowhawk were encountered in better wooded areas. Interestingly, for the last three years a pair of redheaded merlins have nested on the market-place tower in the busiest and most densely populated part of the city.

Such is the glimpse in the life of birds of a busy Indian city. For us city-dwellers it was an exciting and thrilling experience to count birds and record their characteristics. As the city continues to grow it will unwittingly affect the lives of its birds, until a stage comes when its citizens may feel like having a second look at the birds living in it.

TABLE 1

LIST OF BIRDS OBSERVED DURING THE BIRD-COUNT

	Scientific Name	English Name
1.	*Podiceps ruficollis*	Indian Little Grebe
2.	*Phalacrocorax niger*	Little Cormorant
3.	*Ardeola grayii*	Indian Pond Heron
4.	*Bubulcus ibis*	Cattle Egret
5.	*Egretta intermedia*	Indian Smaller Egret
6.	*Egretta garzetta*	Little Egret
7.	*Dendrocygna javanica*	Lesser Whistiling Teal
8.	*Anas querquedula*	Garganey Teal
9.	*Nettapus coromandelianus*	Cotton Teal
10.	*Anas acuta*	Pintail
11.	*Elanus caeruleus*	Blackwinged Kite
12.	*Milvus migrans*	Common Pariah Kite
13.	*Milvus migrans lineatus*	Large Indian Kite
14.	*Butastur teesa*	White-eyed Buzzard
15.	*Gyps bengalensis*	White-backed Vulture
16.	*Neophron percnopterus*	White Scavenger Vulture
17.	*Circus aeruginosus*	Marsh Harrier
18.	*Circaetus gallicus*	Short-toed Eagle
19.	*Spilornis cheela*	Crested Serpent Eagle
20.	*Aquila rapax*	Tawny Eagle
21.	*Falco chicquera*	Red-headed Merlin
22.	*Falco tinnunculus*	Kestrel
23.	*Accipiter badius*	Shikra
24.	*Hieraäetus pennatus*	Booted Hawk Eagle
25.	*Accipiter nisus*	Sparrow-hawk
26.	*Perdicula argoondah*	Rock Bush Quail
27.	*Amaurornis akool*	Brown Crake
28.	*Amaurornis phoenicurus*	Whitebreasted Waterhen
29.	*Gallinula chloropus*	Indian Moorhen
30.	*Fulica atra*	Coot
31.	*Porphyrio porphyrio*	Purple Moorhen
32.	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana
33.	*Vanellus indicus*	Red-wattled Lapwing
34.	*Vanellus malabaricus*	Yellow-wattled Lapwing
35.	*Charadrius dubius*	Little-ringed Plover
36.	*Tringa totanus*	Redshank
37.	*Tringa nebularia*	Greenshank
38.	*Tringa ochropus*	Green Sandpiper
39.	*Tringa glareola*	Wood Sandpiper
40.	*Tringa hypoleucos*	Common Sandpiper
41.	*Capella gallinago*	Common Snipe
42.	*Calidris minutus*	Little Stint
43.	*Philomachus pugnax*	Ruff & Reeve
44.	*Himantopus himantopus*	Black-winged Stilt

	Scientific Name	English Name
45.	*Rostratula benghalensis*	Painted Snipe
46.	*Chlidonias hybrida*	Whiskered Tern
47.	*Gelochelidon nilotica*	Gull-billed Tern
48.	*Columba livia*	Blue Rock Pigeon
49.	*Streptopelia chinensis*	Spotted Dove
50.	*Streptopelia senegalensis*	Little Brown Dove
51.	*Psittacula krameri*	Roseringed Parakeet
52.	*Psittacula cyanocephala*	Blossom-headed Parakeet
53.	*Cuculus varius*	Common Hawk-cuckoo
54.	*Eudynamys scolopacea*	Koel
55.	*Centropus sinensis*	Crow-pheasant
56.	*Athene brama*	Spotted Owlet
57.	*Apus affinis*	House Swift
58.	*Halcyon smyrnensis*	White-breasted Kingfisher
59.	*Alcedo atthis*	Common Kingfisher
60.	*Ceryle rudis*	Lesser Pied Kingfisher
61.	*Merops orientalis*	Small Green Bee-eater
62.	*Coracias benghalensis*	Indian Roller
63.	*Upupa epops*	Hoopoe
64.	*Tockus birostris*	Grey Hornbill
65.	*Megalaima haemacephala*	Crimson-breasted Barbet
66.	*Picoides mahrattensis*	Mahratta Woodpecker
67.	*Eremopterix grisea*	Ashy-crowned Finchlark
68.	*Ammomanes phoenicurus*	Rufous-tailed Finchlark
69.	*Galerida malabarica*	Malabar Crested Lark
70.	*Mirafra erythroptera*	Red-winged Bushlark
71.	*Alauda gulgula*	Eastern Skylark
72.	*Hirundo concolor*	Dusky Crag Martin
73.	*Hirundo rustica*	Eastern Swallow
74.	*Hirundo daurica*	Red-rumped Swallow
75.	*Hirundo smithii*	Wire-tailed Swallow
76.	*Lanius vittatus*	Bay-backed Shrike
77.	*Lanius schach*	Rufous-backed Shrike
78.	*Lanius excubitor*	Grey Shrike
79.	*Oriolus oriolus*	Indian Oriole
80.	*Dicrurus adsimilis*	Black Drongo
81.	*Sturnus pagodarum*	Brahminy Myna
82.	*Sturnus roseus*	Rosy Pastor
83.	*Acridotheres tristis*	Common Myna
84.	*Acridotheres fuscus*	Jungle Myna
85.	*Corvus splendens*	House Crow
86.	*Corvus macrorhynchos*	Jungle Crow
87.	*Coracina melanoptera*	Black-headed Cuckoo-shrike
88.	*Pericrocotus cinnamomeus*	Small Minivet
89.	*Aegithina tiphia*	Common Iora
90.	*Pycnonotus jocosus*	Red-whiskered Bulbul
91.	*Pycnonotus cafer*	Red-vented Bulbul

	Scientific Name	English Name
92.	*Turdoides malcolmi*	Large Grey Babbler
93.	*Turdoides striatus*	Jungle Babbler
94.	*Chrysomma sinensis*	Yellow-eyed Babbler
95.	*Muscicapa parva*	Red-breasted Flycatcher
96.	*Rhipidura aureola*	White-browed Fantail Flycatcher
97.	*Cisticola juncidis*	Streaked Fantail Warbler
98.	*Prinia subflava*	Indian Wren Warbler
99.	*Prinia socialis*	Ashy Wren Warbler
100.	*Orthotomus sutorius*	Tailor Bird
101.	*Acrocephalus stentoreus*	Great Reed Warbler
102.	*Acrocephalus dumetorum*	Blyth's Reed Warbler
103.	*Prinia hodgsonii*	Franklin's Wren Warbler
104.	*Phylloscopus trochiloides*	Greenish Leaf Warbler
105.	*Sylvia curruca*	Lesser Whitethroat
106.	*Erithacus svecicus*	Blue-throat
107.	*Copsychus saularis*	Magpie Robin
108.	*Saxicola caprata*	Pied Bushchat
109.	*Saxicola torquata*	Stone Chat
110.	*Saxicoloides fulicata*	Indian Robin
111.	*Oenanthe deserti*	Desert Wheatear
112.	*Monticola solitarius*	Blue Rock Thrush
113.	*Phoenicurus ochrurus*	Black Redstart
114.	*Parus major*	Grey Tit
115.	*Anthus similis*	Brown Rock Pipit
116.	*Anthus trivialis*	Tree Pipit
117.	*Motacilla caspica*	Grey Wagtail
118.	*Motacilla flava beema*	Blue-headed Yellow Wagtail
119.	*Motacilla citreola*	Yellow-headed Wagtail
120.	*Motacilla alba*	White Wagtail
121.	*Motacilla maderaspatensis*	Large Pied Wagtail
122.	*Dicaeum erythrorhynchos*	Tickell's Flowerpecker
123.	*Nectarinia zeylonica*	Purple-rumped Sunbird
124.	*Nectarinia asiatica*	Purple Sunbird
125.	*Zosterops palpebrosa*	White-eye
126.	*Passer domesticus*	House Sparrow
127.	*Ploceus philippinus*	Weaver Bird
128.	*Lonchura malabarica*	White-throated Munia
129.	*Lonchura punctulata*	Spotted Munia
130.	*Estrilda amandava*	Red Munia

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MAMMALS FROM NEPAL[1]

David H. Johnson, S. Dillon Ripley, and Kitti Thonglongya[2]

(*With a text-figure*)

In 1948-1949, S. Dillon Ripley led a field party to Nepal to collect natural history specimens for Yale University and the Smithsonian Institution. One hundred twelve specimens of mammals were obtained. Subsequent study showed that thirty-five species were represented. New records from Nepal include *Tupaia glis, Vulpes bengalensis* and *Lepus grahami*. The latter identification, based on an immature specimen, is included with reservation.

INTRODUCTION

S. Dillon Ripley

In 1947 I made my first visit to Nepal at the conclusion of a six-month bird collecting reconnaissance in the subcontinent of India. Prior to that time, my Indian colleague, Dr. Sálim Ali, and I made an informal pact that we would work together to prepare an up-to-date listing as well as a handbook on the bird fauna of this huge region, a project on which we would be occupied for the next twenty-seven years. In fact, we are still (in 1979) engaged in revising my SYNOPSIS of the birds of the region, published in 1961, and now being reprinted. The first two volumes of our joint ten-volume HANDBOOK (1968-1974) are being re-edited and published anew.

In 1948-1949, I revisited Nepal, encouraged by the then Government and financed with a major grant-in-aid from the National Geographic Society, as well as support from Yale University (my then employer), and the Smithsonian Institution, whose Secretary, Dr. Alexander Wetmore, distinguished naturalist of his time, was always keen to stimulate natural history research. On this lengthy trip, I was joined by two graduates of the year, roommates at Yale, whom I had come to know as a Resident Fellow in theirs and my college, Jonathan Edwards. The two young men, Richard Mack and Howard Weaver, knocked on my door one evening and said that they had heard I was off again to Nepal and could they come? I responded by saying that I needed some help in small mammal collecting and if they would learn from our Peabody Museum assistants, perhaps they could qualify.

The collection which they subsequently made, assisted in part by Edward C. Migdalski, my principal assistant, who had helped me on my trek in the previous season, is finally reported on herewith. The research was begun in the late 1950's by David H. Johnson, formerly of the National Museum of Natural History's staff, and continued in the 1960's by the late Kitti Thonglongya, a research fellow on a visit from Thailand. The publication fulfils a pledge which I made to the then Secre-

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tary of the National Geographic Society, Melvin M. Payne, that publications in natural history would indeed follow from this expedition! I have dedicated much subsequent correspondence over the years to this end, but still have to report failure in having the collection of fishes published as reported in my Research Report to the National Geographic Society (1975).

The collection of thirty-five species and one hundred twelve specimens, while not startling in its addition to new knowledge of Nepalese mammals, seems worthy of putting on record to inform future workers of the material that is available for study in the National Museum of Natural History.

I am most grateful to my colleagues, Messrs Mack and Weaver, for their participation, as well as to the societies and institutions which afforded us the opportunity for our field work. It has been a recent great pleasure to me and to the Smithsonian Institution to pick up the threads of collaboration again with the Government of Nepal in connection with the first scientifically-documented study of the life-history of the tiger, *Panthera tigris*, now being undertaken at the Royal Chitwan National Park in Nepal by a Nepalese-American team with support from the Smithsonian Institution and the World Wildlife Fund. Much of what I wrote earlier (1950 *et seq.*) about the deforestation and decline of animal life along the broad sweep of the Himalayas has come to pass. It is rewarding to note, however, that the Royal Government of Nepal has seen fit to take positive steps to protect certain areas as national parks, and to institute research on life-history studies of the larger mammals such as rhinoceros, tiger, and some species of deer. All of these studies promise well for the future economy and preservation of this unique part of the world.

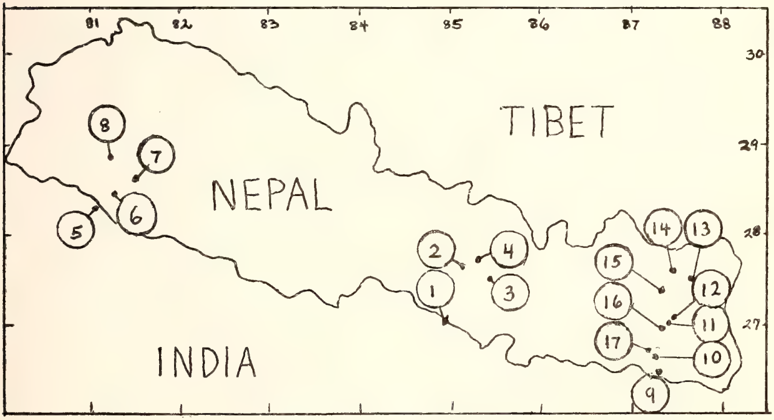

Fig. 1. Collecting localities.

Collecting Localities

The itinerary of the expedition has been outlined by Ripley (1950: 355-359), who also gives brief descriptions of some of the collecting localities. The places at which mammals were collected are listed below in the order that the first specimens were taken. The latitude and longitude are from Army Map Service 1:250,000 maps of India and Pakistan, Series U-502, published in parts from 1958 to 1963. The inclusive dates on which specimens of mammals were collected and a list of the kinds found at each place are also included. The serial numbers correspond to those on the accompanying map (Fig. 1).

1. Raxaul-Birganj, adjacent border towns in Bihar and Nepal, respectively, 350 feet. 27° 0′ N., 84° 57′ E. November 16-18 and December 7. *Suncus caerulaeus, Scotophilus heathii heathii, Canis aureus indicus.*
2. Chandragiri Pass, central Nepal, 7000-7500 feet. 27° 41′ N., 85° 10′ E. November 22 and December 6, *Dremomys lokriah lokriah.*
3. Godaveri, central Nepal, 6000-7000 feet. 27° 34′ N., 85° 24′ E. November 27-28. *Dremomys lokriah lokriah, Rattus nitidus nitidus, Mus nagarum..*
4. Katmandu, central Nepal, 4271-4500 feet. 27° 42′ N., 85° 20′ E. December 2-5. *Bandicota bengalensis bengalensis, Vulpes bengalensis.*
5. Kauriala Ghat, United Provinces, 400 feet. 28° 22′ N., 81° 02′ E. December 11-12. *Lepus ruficaudatus ruficaudatus, Tatera indica indica.*
6. Tikapur, western Nepal, 500 feet. 28° 30′ N., 81° 10′ E. December 13 and January 6-9. *Suncus murinus tytleri, Tatera indica indica, Rattus rattus gangutrianus, Mus booduga booduga, Mus dunni, Mus cervicolor cervicolor, Herpestes edwardsii nyula.*
7. Chisapani, western Nepal, 950 feet. 28° 38′ N., 81° 17′ E. December 16-21. *Suncus murinus tytleri, Cynopterus sphinx gangeticus. Presbytis entellus schistaceus, Rattus rattus gangutrianus, Mus booduga booduga, Mus saxicola gurkha, Canis aureus indicus, Lutra perspicillata perspicillata.*
8. Rekcha, western Nepal, 5000 feet. 28° 53′ N., 81° 10′ E. December 27-31. *Suncus murinus tytleri, Rattus rattus gangutrianus, Rattus turkestanicus vicerex, Mus cervicolor cervicolor.*
9. Biratnagar, eastern Nepal, 250 feet. 26° 28′ N., 87° 17′ E. January 18. *Mus booduga booduga.*
10. Dharan Bazar, eastern Nepal, 1000 feet. 26° 49′ N., 87° 17′ E. January 22. *Callosciurus pygerythrus lokroides, Sus scrofa cristatus.*
11. Chitre, eastern Nepal, 7500 feet. A hamlet not shown on current maps but located on the main ridge twelve miles north of Dhankuta (q.v.) January 28. *Soriculus caudatus, Rattus niviventer niviventer, Mus musculus homourus.*
12. Dur, eastern Nepal, 8500 feet. A hamlet not shown on current maps but located on the main ridge eighteen miles north of Dhankuta (q.v.). January 29. *Rattus eha eha.*
13. Mangalbare, eastern Nepal, 8650-8750 feet. 27° 16′ N., 87° 30′ E. January 30-February 6. *Soriculus caudatus, Soriculus macrurus, Lepus grahami, Petaurista magnificus, Rattus rattus brunneusculus, Rattus eha eha, Mus musculus homourus, Martes flavigula flavigula.*
14. Chainpur, eastern Nepal, 4300 feet. 27°

17′ N., 87° 19′ E. February 9. *Herpestes auropunctatus auropunctatus*.

15. Riçhavas, eastern Nepal, 1150 feet. Not shown on current maps. On the east bank of the Arun Kosi just south of its confluence with the Legua river. 27° 9′ N., 87° 16′ E. February 11, *Mus nagarum*.
16. Dhankuta, eastern Nepal, 4200 feet. 26° 59′ N., 87° 21′ E. February 14. *Callosciurus pygerythrus lokroides*.
17. Chatra, eastern Nepal, 500 feet. 26° 51′ N., 87° 10′ E. February 18-21. *Tupaia glis lepcha, Callosciurus pygerythrus lokroides, Rattus rattus brunneusculus, Paradoxurus hermaphroditus pallasii*.

Order INSECTIVORA

Family SORICIDAE

Soriculus caudatus (Horsfield, 1851)

Ten specimens: Chitre, 7500 feet, January 28, 1 (290036); Mangalbare, 8650-8750 feet, January 31-February 4, 9 (290037-45).

We consider *Soriculus leucops* (Horsfield, 1855) with very similar characters, to be a synonym of *S. caudatus*.

Soriculus macrurus Blanford, 1888

Two specimens: Mangalbare, 8750 feet, February 2 and 4 (290034-35).

The two species of *Soriculus* reported upon here may be separated on the basis of tail length and colour. *S. caudatus* has the tail similar to or approaching the head and body in length (an index ratio of 80-108 per cent in the specimens examined), and in its general aspect the dorsal coloration is a warm dark brown; whereas, *macrurus* has the tail considerably longer than the head and body (an index ratio of *c.* 140 per cent) and the dorsal coloration is a cold gray hue approaching Chaetura Drab of Ridgway (1912).

Ellerman and Morrison-Scott (1951, p. 59) recognize the dark *caudatus* and the very similar *leucops* as separate species and unaccountably consider the very pale and distinct *macrurus* to be a synonym of *leucops*.

Suncus murinus tytleri (Blyth, 1859)

Ten specimens: Chisapani, 950 feet, (December 16-19, 3 (290047-49); Rekcha, 5000 feet, December 27-29, 6 (290050-55); Tikapur, 500 feet, January 9, 1 (290056).

The entire series of brown musk shrews from localities at different elevations in western Nepal is uniformly pale in colour, showing affinity with the pallid shrews of the drier parts of north-western India rather than with the darker coloured races towards the east. Apparently they are similar to the eight specimens from western Nepal referred to *tytleri* by Lindsay (1929, p. 332). No specimens of *tytleri* are now available to us, but the colour "light rufescent sandy-brown" originally ascribed to it by Blyth would seem to indicate a population even paler than that in western Nepal.

Suncus caerulaeus (Kerr, 1792)

One specimen; Raxaul-Birganj, 350 feet, November 18 (290046).

The external and cranial dimensions of this species are less than those of adults of *Suncus caerulaeus* but exceed adults of *Suncus murinus*. (*caerulaeus*—one female head and body length 123; breadth of braincase 13.4, vs. *murinus*—four females average 112.5; 121 mm respectively.) Ellerman and Morrison-Scott (1951, pp. 65-66) have merged these two species but such an arrangement is untenable when specimens are compared.

Family TUPAIIDAE

Tupaia glis lepcha Thomas, 1922

Two specimens: Chatra, 500 feet, February 18 and 20 (290063-64).

This is apparently the westernmost record of the occurrence of tree shrews north of the Ganges river, and it definitely establishes the presence of the group in Nepal.

Order CHIROPTERA

Family PTEROPODIDAE

Cynopterus sphinx gangeticus Anderson, 1910[3]

Four specimens: Chisapani, 950 feet, December 20-21 (290057-60).

Family VESPERTILIONIDAE

Scotophilus heathii heathii (Horsfield, 1831)

Two specimens: Raxaul-Birganj, 350 feet, November 16-17 (290061-62). No. 290061 is a skin only.

Order PRIMATES

Family CERCOPITHECIDAE

Presbytis entellus schistaceus (Hodgson, 1840)

Two specimens: Chisapani, 950 feet, December 20, 1 (290065); Chatra, 500 feet, February 17, 1 (290066).

Order LAGOMORPHA

Family LEPORIDAE

Lepus ruficaudatus ruficaudatus
I. Geoffroy, 1826

One specimen: Kauriala Ghat, U.P., 400 feet, December 11 (290067, skull only).

Among the few skulls of hares from the Indian region in the National Museum of Natural History, the present one best matches specimens from Sirsa and Ladak labelled *Lepus ruficaudatus rajput*, differing from them only in having smaller auditory bullae. Contradictory opinions as to the relationship of *Lepus ruficaudatus* to the Oriental hares have been expressed by Ellerman and Morrison-Scott (1951, p. 437) and Petter (1961, pp. 36-38). These authors studied different specimens and relied on different morphological characters. The need for a comprehensive revision is evident.

Lepus grahami subsp?

One specimen: Mangalbare, 8750 feet, February 2 (290068).

A woolly-coated juvenile hare from Mangalbare is too young for positive identification. It is hoped that those who have the opportunity to make new collections in Nepal, or to study some of the old material will look for adult hares of whatever race the young Mangalbare specimen represents.

Order RODENTIA

Family SCIURIDAE

Callosciurus pygerythrus lokroides
(Hodgson, 1836)

Five specimens: Dharan Bazar, 1000 feet, January 22, 1 (290074); Dhankuta, 4200 feet, February 14, 2 (290075-76); Chatra, 500 feet, February 18-19, 2 (290077-78).

As arranged by Ellerman (1947, pp. 266-267), all the recognizable forms of this group of squirrels are currently treated as subspecies of a single species, which takes the earliest name, *pygerythrus*. Under this convenient but perhaps overly simplified classification, all the populations inhabiting the base and lower slopes of the Himalayas from northern Assam to Nepal are referred to one subspecies, *C. p. lokroides*. For present purposes, we have followed Ellerman's arrangement, but with some doubt as to its ultimate stability.

Dremomys lokriah lokriah (Hodgson, 1836)

Five specimens: Chandragiri Pass, 7500 and 7000 feet, November 22 and December 6, 4 (290069-71, 290073); Godaveri, 7000 feet, November 27, 1 (290072).

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[3] Agarwal (1973) considers *gangeticus* to be a synonym of *C. s. sphinx*.

Petaurista magnificus (Hodgson, 1836)

One specimen: Mangalbare, 8750 feet, February 4 (290079).

Family CRICETIDAE

Tatera indica indica (Hardwicke, 1807)

Two specimens: Kauriala Ghat, 400 feet, U.P., December 12, 1 (290080); Tikapur, 500 feet, January 7, 1 (290081).

Family MURIDAE

Bandicota bengalensis bengalensis (Gray, 1833)

One specimen: Katmandu, 4271 feet, December 2 (290082).

Rattus rattus gangutrianus Hinton, 1919

Eight specimens: Chisapani, 950 feet, December 16-19, 3 (290084-86); Rekcha, 5000 feet, December 17-31, 4 (290087-90).

An immature animal, sex not recorded on the specimen tag but noted in the field-notes as a male, from Tikapur, 500 feet, January 9, 1949 (290091).

All of the specimens treated in this and the following accounts are of the white-bellied type which students of Indian house rats have generally designated as "outdoor" forms. None of the dark-bellied "indoor" rats are represented. The subspecies of *Rattus rattus* are notoriously difficult to define, and it is therefore gratifying to find that the present Nepalese material divides readily into uniform western (*gangutrianus*) and eastern (*brunneusculus*) series separated by easily recognizable colour differences. The simplicity of this distributional pattern is probably in part an illusion, made possible by the smallness and wide geographic separation of the series. Both Hinton (1918-1919) and Ellerman (1947) studied much larger series and found a more complex and confused taxonomic situation.

Rattus rattus brunneusculus (Hodgson, 1845)

Nine specimens: Mangalbare, 8750 feet, January 31-February 4, 8 (290092-99); Chatra, 500 feet, February 21, 1 (290100).

Rattus turkestanicus vicerex (Bonhote, 1903)

Two specimens: Rekcha, 5000 feet, December 28-31, 1948, 2 (290102-290103).

For use of the above name, see Schlitter and Thonglongya (1971).

Rattus nitidus nitidus (Hodgson, 1845)

One specimen: Godaveri, 6000 feet, November 28 (290083).

An adult female, with three pairs of pectoral and three pairs of inguinal mammae.

Rattus eha eha (Wroughton, 1916)

Twelve specimens: Dur, 8500 feet, January 29, 1 (290109); Mangalbare, 8750 feet, January 31-February 3, 11 (290110-20).

Rattus niviventer niviventer (Hodgson, 1836)

Five specimens: Chitre, 7500 feet, January 28 (290104-08).

Mus booduga booduga (Gray, 1837)

Four specimens: Chisapani, 950 feet, December 18, 1 (290127, skin only); Tikapur, 500 feet, January 7, 1 (290130); Biratnagar, 250 feet, January 18, 2 (290132-33, the first a skin only).

Mus nagarum (Thomas, 1921)

Four specimens: Godaveri, 6000 feet, November 28, 1 (290126); Rekcha, 5000 feet, December 28-29, 2 (290128-29); Richavas, 1150 feet, February 11, 1 (290134).

Mus dunni (Wroughton, 1912)

One specimen: Tikapur, 500 feet, January 9, 1 (290131).

Mus musculus homourus Hodgson, 1845

Two specimens: Chitre, 7500 feet, January

28, 1 (290124). Mangalbare, 8750 feet, February 6 (290125).

Mus saxicola gurkha (Thomas, 1914)

Three specimens: Chisapani, 900 feet, December 21 (290121-23).

Order CARNIVORA

Family CANIDAE

Canis aureus indicus Hodgson, 1833

Two specimens: Raxaul-Birganj, 350 feet, December 7, 1 (290135); Chisapani, 950 feet, December 18, 1 (290136).

Vulpes bengalensis (Shaw, 1800)

One specimen: Katmandu, 4500 feet, December 5 (290137, skin only).

This specimen is significant in that it provides a first definite locality record for the Bengal fox in Nepal and eliminates any doubt as to the occurrence of the species in that country. As reviewed by Pocock (1936, pp. 49-53, and 1941, pp. 129-138), the earliest records include only two specimens presumed to have been collected somewhere in Nepal. One from the collection of B. H. Hodgson became the type of *Vulpes hodgsonii* Gray; the other was collected by Colonel Cobb (or Cobbe) and, according to Pocock, it served as type for *Canis chrysurus* and *Vulpes xanthura*, both proposed by Gray.

The specimen is a female in fresh winter pelage. It matches in almost exact detail the description by Pocock (1941, p. 131). The external measurements, as recorded by the collectors are: Length of head and body 474, tail 267, hind foot 105, ear 87.

Family MUSTELIDAE

Martes flavigula flavigula (Boddaert, 1784)

Three specimens: Mangalbare, 8750 feet, January 30- February 3 (290138-40).

Lutra perspicillata perspicillata
I. Geoffroy, 1826

One specimen: Chisapani, 950 feet, December 20 (290145).

The name *perspicillata* is applied to this large otter for reasons discussed in detail by Pocock (1941, pages 292-303).

Family VIVERRIDAE

Paradoxurus hermaphroditus pallasii
Gray, 1832

One specimen: Chatra, 500 feet, February 21 (290144).

On geographic grounds, this specimen might be considered intermediate between *Paradoxurus h. pallasii,* which has its principal range to the eastward in Sikkim, Assam, and Burma, and *P. h. bondar* of Bihar and the Nepal terai to the westward. It is here assigned to the race *pallasii* because it closely resembles the description given by Pocock (1939, pp. 401-402) of other specimens in winter pelage under that name.

Herpestes auropunctatus auropunctatus
(Hodgson, 1836)

One specimen: Chainpur, 4300 feet, February 9 (290141).

Herpestes edwardsii nyula (Hodgson, 1836)

Two specimens: Tikapur, 500 feet, December 13 and January 6 (290142-43).

Variations in colour of this species have been thoroughly discussed by Pocock (1941, pp. 9-12).

Order ARTIODACTYLA

Family SUIDAE

Sus scrofa cristatus Wagner, 1839

One specimen: Dharan Bazar, 1000 feet, January 22 (290146).

REFERENCES

AGARWAL, V. C. (1973): Second Zoological Survery of India—1967: Calcutta.

ALI, S. & RIPLEY, S. D. (1968-1974): Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Sikkim, Bhutan and Sri Lanka. 10 volumes. Oxford University Press, Bombay.

ELLERMAN, J. R. (1947): A key to the Rodentia inhabiting India, Ceylon, and Burma, based on collections in the British Museum. *J. Mammal. 28*: 249-278, 357-387.

ELLERMAN, J. R., & MORRISON-SCOTT, T. C. S. (1951): Checklist of Palaearctic and Indian Mammals 1758 to 1946. British Museum (Natural History), London, pp. 810, map.

HINTON, MARTIN, A. C. (1918-1919): Scientific Research from the Mammals Survey, xviii: Report on the House Rats of India, Burma and Ceylon. *J. Bombay nat. Hist. Soc., 26*: 59-88, 384-416, 716-725, 906-918.

LINDSAY, HELEN M. (1929): Scientific Results from the Mammal Survey, xlviii: Indian Shrew. ibid. *33*: 326-340.

PETTER, F. (1961): Eléments d'une révision des Lievres européens et Asiatiques du sous-genre Lepus. *Zeitschrift für Säugetierkunde. 26* (1): 30-40.

POCOCK, R. I. (1936): The foxes of British India. *J. Bombay nat. Hist. Soc. 39*(1): 36-57.

———— (1939): The Fauna of British India, Including Ceylon and Burma: Mammalia, volume I: Primates and Carnivora (in part), Families Felidae and Viverridae. Taylor and Francis, London. pp. 463.

———— (1941): The Fauna of British India, including Ceylon and Burma. Mammalia, Volume II. Carnivora (continued from Vol. I), suborder Aeluroidea (part) and Arctoidea. Taylor and Francis, London. pp. 503.

RIDGWAY, R. (1912): Color Standards and Color Nomenclature. Privately printed, Washington. pp. 43, pl. 53.

RIPLEY, S. D. (1950): Birds from Nepal, 1947-1949. *J. Bombay nat. Hist. Soc. 49*(3): 355-417.

———— (1950a): New Birds from Nepal and the Indian Region. *Proc. Biol. Soc. Washington 63*: 101-108.

———— (1950b): Peerless Nepal—A Naturalist's Paradise. *Nat. Geog. Mag., 97*(1): 1-40.

———— (1951): Exploration in Nepal. *The Minnesota Naturalist, 1*(4): 7.

———— (1952): Search for the Spiny Babbler: and adventure in Nepal. Houghton Mifflin, Boston, pp. 301 (Republished 1953, London, Victor Gollancz Ltd.)

———— (1961): A Synopsis of the Birds of India and Pakistan together with those of Nepal, Sikkim, Bhutan and Ceylon. Bombay Natural History Society, Bombay. pp. 703. (new and revised edition in press, 1980).

———— (1975): Zoological Expedition to Nepal, 1948-1949. (Paul H. Oehser, editor). *Nat. Geog. Soc. Res. Reports,* 1890-1954 *Projects,* pp. 271-276.

———— (1978): A Naturalist's Adventure in Nepal. Bibliotheca Himalayica. Ratna Pustak Bhandar, Katmandu. pp. 301. (A reprint of Search for the Spiny Babbler, 1953).

SCHLITTER, D. A. & THONGLONGYA, K. (1971): *Rattus turkestanicus* (Satunin, 1903), the valid name for *Rattus rattoides* Hodgson, 1845 (Mammalia: Rodentia). *Proc. Biol. Soc. Washington 84*(20): 171-174.

PARENTAL CARE IN THE SALTWATER CROCODILE (*CROCODYLUS POROSUS* SCHNEIDER) AND MANAGEMENT IMPLICATIONS[1]

H. R. Bustard[2] and B. C. Choudhury[3]

Local people, who know these crocodiles' habitat intimately, are aware that *porosus* opens the nest, takes hatchlings into their mouths, and assume this as an act of cannibalism. The possible role of the mother taking threatened young in the water back into the mouth is discussed. The female in the water with her brood of approximately 25 young, close to her head is described. Three instances of human attack, two in 1978, by nest-guarding female *porosus* are described, and in all the three instances, the attack was not pursued and is considered as purely defensive of the area adjacent to the nest.

INTRODUCTION

Detailed reviews of parental care in crocodilians are given by Cott (1971) and Bustard (in press, a) with special reference to the Nile Crocodile (*C. niloticus*) and Indian crocodilians (*Gavialis gangeticus, Crocodylus palustris* and *C. porosus* respectively). The present paper, therefore, does not attempt to review the literature for species other than *C. porosus*. For accounts of parental care in general, the reader is referred to the review papers cited above.

Smith (1931) wrote of the female *porosus*, "She is said to remain in the vicinity until the young are hatched possibly to assist them to the water when they emerge from the shell".

This has now been confirmed.

C. porosus is now well-known to protect its mound nest Deraniyagala (1939); Cott (1971); Bustard (in press, a); Choudhury and Bustard (1979). Nest-guarding is usually carried out from specially constructed wallows adjacent to the nest (Deraniyagala 1939; Loveridge 1946; Choudhury and Bustard 1979). It is remarkable that Neill (1971) does not believe this species constructs wallows for nest-guarding, and that Webb *et al.* (1977) could write,

"It is not known whether *C. porosus* protects the nest against predators or not".

As pointed out by both Cott and Bustard (see, for instance, Cott 1971; Bustard, in press, b) behaviour of crocodiles has been much altered by massive human hunting activity. Nest-guarding females are particularly vulnerable (Bustard 1969, in press, b; Choudhury and Bustard 1979). This has resulted in the destruction of those females which guard the nest against humans, so that this trait—at least in as far as humans are concerned—is not now frequently exhibited. However, Bustard and Kar (in press) present recent data from Orissa, (see below for other recent instances) and there is no reason to believe

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that nest-guarding does not still continue against animals other than man. Cott (1971) documents several attacks directed against man by nest-guarding female *C. porosus*. It is noteworthy, however, that all occurred at least three decades ago, prior to the massive hunting phase which commenced in the post-war years.

According to our data the female crocodile does not remain at the nest throughout the incubation period but comes and goes from the river (Choudhury and Bustard 1979) along a path which may be well worn in the presence of grassy vegetation (Bustard unpub. obs.). The first quantitative study of nest-guarding, by a captive *C. porosus*, given by Bustard and Maharana (in press), demonstrates that absences from the nest, usually of short duration, are common place.

Pooley (1974) and Pooley and Gans (1976) have recorded female *C. nilotious* collecting newly hatched young, storing them in her gular throat pouch, then taking them to the water for liberation.

Webb *et al.* (1977) record nest opening by the female and state,

"Most hatchlings remained with the adult, grouped in a few square metres for up to and possibly more than two months after hatching."

C. porosus is, therefore, known to guard the nest, presumably to liberate the hatchlings and facilitate their reaching the water, and to stay with them for an extended period thereafter.

MATERIALS AND METHODS

The data presented here are based on discussions with people who have had a lifetime's experience with *C. porosus* when it was still abundant and had little contact with hunters. Such data cannot be obtained today. It is also based on personal observations where stated.

RESULTS

Discussions with Australian aborigines:

One of us (H.R.B.) worked closely with Australian aborigines, particularly in North Queensland, but also in the Northern Territory and in Western Australia, in the late 1960's and early 1970's. On several occasions he was told quite adamantly by tribal aborigines, whose very survival depends on their acute powers of observation, that they had *personally* observed *C. porosus* taking the young into their mouth (they said "gobbling up the young"). This behaviour was cited as evidence of cannibalism. The informants were tribal elders, who had spent a lifetime observing nature.

At the time, while I doubted that a parent would eat its own young—as was inferred by an adult with a brood of young taking them into its mouth—I was unable to explain what they had obviously seen. It was not until A.C. Pooley told me that the mother *C. niloticus* collects the young in the gular throat pouch to take them to the water from the nest following hatching, that I realised what the aborigines had witnessed. They had witnessed females at the time of hatching, collecting the young as described by Pooley (1974), and Pooley and Gans (1976), and mistakenly deduced that the adult crocodile, presumbaly the mother, was in the act of eating her young.

I have also heard from the same informants that the adult crocodile may take the recent hatchlings into her mouth when they are in the water, that is some time after hatching. Again they assume that this is an act of cannibalism. Could it be that, suddenly suprised, the female gathers up a number of her brood to take them to safety? This suggestion may not be as far fetched as it sounds as is outlined below.

Discussion with an Oriyan crocodile hunter:

One of us (H.R.B.) talked to an old man, a former crocodile hunter, employed by the former Raja of Kanika in Bhitar Kanika the famous crocodile habitat in the Brahmini-Baitarani deltaic area of the Eastern Indian State of Orissa. His task was to keep a watch on people who purchased the right to shoot crocodiles from the Raja, in order to ensure they kept to the stipulated conditions. This informant gave me an eye-witness account of an event which happened over thirty years ago. He remembered it clearly, being interested in crocodiles, as it was the only time he ever observed this,

"I came upon a large crocodile one day when I was out in my dinghy and I noticed that there were a number of babies around its head. I paddled closer to have a good look. Before I could get very close the adult crocodile took the babies into its mouth and swam away."

If this account is to be believed—and there is no reason to doubt it, as the old man is only reporting what he saw with his own eyes—then it is a clear account of a female removing hatchlings, presumably recently hatched, from the scene of presumed danger, by taking them back into the gular throat pouch.

Discussions with a crocodile hunter in the Andaman Islands:

While carrying out field work relating to nest location and nesting ecology on North Andaman Island in 1978, one of us (B.C.C.) employed as guides, persons with at least several years experience in crocodile hunting. One of these guides had migrated to India from what is now Bangladesh in the late 1940's. He operated as professional saltwater crocodile hunter first in Sunderbans (West Bengal), then in the Bhitar Kanika area of Orissa and later with the East Bengal refugee settlement he went to the Andamans where he continued crocodile hunting. This informant, aged about 50 years, has an intimate knowledge of saltwater crocodiles having observed them in all three of their surviving Indian habitats. In a discussion of the ease with which nest-guarding females can be killed, he confirmed that he had been charged at by many nest-guarding female saltwater crocodiles.

This informant has also observed nest hatching in nature. He informed that the mother supervises the whole operation of opening the nest and allowing the hatchlings to emerge from the egg this fits in perfectly with Pooley's (1974) observations and those of other recent authors (see Bustard, in press a and b) for other species and then eats them up, one after the other. It would appear that this informant has observed the female collecting the young to take them to the water as described by Pooley (1974). He further stated that only those hatchlings which come out from the side of the nest mound away from the parent crocodile survive, and he believes that this is one reason why so few young crocodiles are seen.

Observation of C. porosus with young in Andamans:

On 13 July 1978, while searching for nests along one of the (unnamed) creeks on the West coast of North Andaman, one of us (B.C.C.) saw a 2.7 m crocodile, presumably a female, with its brood of approximately 25 hatchlings. The head region of the creeks in this area show an alternation of small rapids and deep pools, the latter particularly on sharp bends. The group was located in such a deep pool below a rapid. These pools always have overhanging vegetation on the deep water side.

The young, with the parent crocodile, were observed at about 4.30 p.m. on a very cloudy, drizzling day with poor visibility. The head of the mother crocodile and the hatchling group could be discerned but conditions did not permit photography. All the hatchlings were within a distance of 10 m. One of the guides who had gone ahead to the other bank in the meanwhile came into view, and being disturbed, the mother sub-merged first, followed immediately thereafter by the hatchlings. Most of the hatchlings were very close to the mother's head rather than to the tail.

Active defence of the nest against man:

Case History 1

During the 1978 nesting season in North Andaman, a case of human attack by a nest-guarding female was recorded. On 22nd June 1978 while searching for nests, in the Laxmipur nullah, a tributary of the Kalpang River on the East coast of North Andaman, a crocodile was observed by one of us (B.C.C.) in the stream. A robbed crocodile nest was located very nearby. Two old ladies were fishing with rods on the bank of this stream. Before leaving the place the old ladies were warned about the presence of a nest-guarding crocodile in the water nearby.

One of the old ladies, aged about 45-50 years, had been attacked by a nest-guarding female crocodile, possibly the same one, at the same spot during 1976, yet seemed not to heed the warning. The crocodile had bitten her on the buttocks and a portion of the flesh of this region was subsequently removed when she was hospitalised. At the time of attack she was standing in water of approximately three feet depth in the bed of the river, at low tide, fishing with a cloth scoop.

Four days later, on 26 June 1978 returning to that area it was learned that the same lady had been attacked by the crocodile again that morning. On enquiry it was learned that during the low tide, the ladies were again using scoop nets in the stream and while doing so one of them was attacked by the crocodile. She was rescued by the other lady but one of her hands was subsequently amputated in hospital, the crocodile having grabbed her by the left wrist.

The nearby nest being located on hard ground, did not have a wallow, and presumably the mother crocodile was using the adjacent portion of the stream for nest-guarding purposes.

Case History 2

During the 1978 nesting season a second case of human attack by a nest-guarding female was recorded in North Andaman, in a creek near Kishorinagar village on the West coast. A boy, aged about 12 years, was attacked by a crocodile while taking his bath, along with a group of boys. The attack was not severe, consisting only of a small injury at the shoulder region.

Some days later the female was killed by the villagers by the nest which was also robbed. The female measured 2.6 m. The nest-site, checked later, had only one wallow but the permanent water in the stream was hardly 5 m away. Clearly, as in the instance cited above, the female was watching the nest part of the time from the stream.

DISCUSSION

In the cases of human attack recorded above by nest-guarding females, it is noteworthy that only minor damage was sustained. This is thought to reflect not the assistance of another old lady on two of the occasions or other boys on the third occasion, but the fact that these attacks were purely defensive—by the nest-guarding female against a person or persons coming too close to the nest. Food is abundant and few attacks on humans are recorded in the Andamans. It is likely that further investigation of the latter would indicate that many/most of them were occasioned by nest-guarding females. These data are in agreement with the discussion which one of us (H.R.B.) held with A. C. Pooley in 1973 in which Pooley informed that most attacks on humans by *C. niloticus* investigated by him could be attributed to nest-guarding females.

The present eye-witness accounts confirm the actual opening of the nests by the adult crocodile, implicitly inferred to take place by Webb *et al.* (1977) but not actually observed for this species but observed in other crocodiles, (Pooley 1974). These data also provide further evidence of the mother remaining with the hatchling brood, also described by Webb *et al.*

The accounts of the tribal aborigines and that of the Oriyan crocodile hunter also suggest that in the wild the adult crocodile may take the recent hatchlings back into the gular throat pouch if danger threatens.

It is not suggested that parental care is able to protect all the hatchlings effectively. In the murky water inhabited by *C. porosus* an aquatic predator can approach undetected and predation takes only a fraction of a second. Furthermore, the large number of hatchlings makes any attempt at individual attention—as could be possible, were there one or at the most two hatchlings—impossible. At least some recent hatchlings occur scattered in nature (Bustard, unpubl. obs., S. Kar pers. comm.) and these have clearly left the hatchling group as noted by Webb *et al.* (1977), who also present preliminary post-hatching movement data.

Data available, however, shed no light on the percentage survival of young which remain with the parental group as compared to those which leave it. Quantitative data on this aspect of parental care are required before any concrete assessment of the advantages of post-hatching parental care can be made. At the present time it can be merely assumed that factors which tend to keep the hatching group together, and closely associated with the head of the mother, have enhanced survival value.

In management of this species it is standard practice in the Government of India Project, on the technical advice of the senior author, to collect all eggs of *C. porosus,* as soon as laid for safe hatchery incubation. All hatchlings are also captive reared to a length of 1.20 m before being 'seeded out' into the wild habitat. There can be no question that this technique enhances survival many-fold under conditions where a substantial level of flooded nests occur—over which the female has no control (the situation in much of Northern Australia), or where human interference with the nest (egg-robbing) is widespread as in parts of India. For instance Webb *et al.* (1977) record an 80% nest loss through flooding alone, and Choudhury and Bustard (1979), a 93.4% nest loss through predation (73.3% due to human agency) with only 3.3% of nests in nature hatching in 1978.

It would be difficult to imagine a natural situation where hatching survival would not be enhanced by collection of freshly-laid eggs, provided, of course, that proper methods of egg handling are used by trained operatives, and a predator-proof hatchery, offering the required micro-environmental parameters of temperature and humidity, available for incubation. Furthermore, hazards such as killing of the nest-guarding female, whose eggs are then extremely vulnerable and the enhanced predation risk when the female is absent from the nest (Bustard 1975) are further factors favouring egg collection for hatchling incubation.

Similarly, a restocking station fed with freshly hatched young should be able to increase the production of 1.20 m crocodiles to many times the number surviving at this size/age in nature. Although predation is an extremely difficult thing to observe in nature there are many hatchling predators recorded (see, Cott 1971) and many other potential predators.

REFERENCES

BUSTARD, H. R. (1969): A future for crocodiles. *Oryx 10*(4): 249-255.

——— (1975): Gharial and Crocodile Conservation Management in Orissa. Interim Report. Crocodile Farming Project, India. UNDP/FAO, FO:IND/71/033. Rome, 1975.

——— (in press, a): Parental Care in Crocodilians with special reference to Indian Crocodilians—a review. *In Indian Crocodiles: Conservation and Research.* Occ. Publs. No. 1. *Cen. Croc. Br. Mgmt. Trg. Inst.*, Hyderabad, India.

——— (in press, b): Crocodile Population Ecology and Management. *Zool. Surv. Ind. Symp. on Anim. Ecol.*

——— & MAHARANA, S. (in press): The Behaviour of the Nest-guarding Saltwater Crocodile (*Crocodylus porosus*, Schneider)—a preliminary quantitative study. *In Indian Crocodiles: Conservation and Research.* Occ. Publs. No. 1. *Cen. Croc. Br. Mgmt. Trg. Inst.*, Hyderabad, India.

——— & KAR, S. K. (in press): Defence of the nest against man by the saltwater crocodile (*Crocodylus porosus* Schneider) *Brit. J. Herpetol.*

CHOUDHURY, B. C. & BUSTARD, H. R. (1979): Predation on natural nests of the Saltwater Crocodile (*Crocodylus porosus*, Schneider) on North Andaman Island with Notes on the crocodile population. *J. Bombay nat. Hist. Soc. 76*(2): 311-323.

COTT, H. B. (1971): Parental care in the Crocodilia with special reference to *Crocodylus niloticus*. *In Crocodiles. 1.* I.U.C.N. Publs. N.S. Suppl. Pap. No. *32*: 166-180.

DERANIYAGALA, P. E. P. (1939): The Tetrapod Reptiles of Ceylon. *1.* Testudinates and Crocodilians. Colombo Museum, Ceylon.

LOVERIDGE, A. (1946): Reptiles of the Pacific World. Macmillan, New York.

NEILL, W. T. (1971): The Last of the Ruling Reptiles. Alligators, Crocodiles and their Kin. Columbia University Press, New York.

POOLEY, A. C. (1974): Parental Care in the Nile Crocodile—a preliminary report on behaviour of a captive female. *The Lammergeyer 21*: 43-45.

——— & GANS, CARL (1976): The Nile Crocodile. *Scientific American 234*(4): 114-124.

SMITH, M. A. (1931): The Fauna of British India. Reptilia and Amphibia. 1. Taylor and Francis, London.

WEBB, G. J. W., MESSEL, H. & MAGNUSSON, W. (1977): The Nesting of *Crocodylus porosus* in Arnhem Land, Northern Australia. *Copeia*, 1977(2): 238-50.

EGGS AND EARLY DEVELOPMENT OF TOR MAHSEER FISH[1]

C. V. KULKARNI[2]

(*With four text-figures*)

Tor tor (Ham.), normally occurring in the rivers of northern India has been introduced into the Walwhan lake near Lonavala (Dist. Pune, Maharashtra). It was bred artificially by stripping for the first time and its eggs and larval stages are described and compared with those of *T. khudree* (Sykes).

Mahseers being the most important group of sport fishes of India and having been threatened with severe decline in their fishery, the National Commission on Agriculture (Fisheries Section) felt that the biological information available to date was not sufficient and recommended (1976) "extensive survey and detailed ecological and biological investigations". Sporadic efforts to study larval development had commenced with Nazir Ahmed (1948) in the case of the Assamese Copper Mahseer, *Barbus* (*Lissocheilus*) *hexagonolepis* (McClelland) (now *Acrossocheilus hexagonolepis*). David (1953) described the early fry of *Tor mosal mahanadicus* collected from Mahanadi river and Desai (1972 and 1973) studied the biology and early post larval stages of *Tor tor* (Ham.) and *T. putitora* (Ham.) collected from Narmada river and Chaturvedi (1976) investigated the spawning biology of Tor Mahseer of the Udaipur lakes and streams. Kulkarni (1971) and Tripathi (1978) dealt with artificial fertilisation of eggs, embryonic development and larval stages of *T. khudree* (Sykes) and *T. putitora* (Ham.) respectively. However, fully matured eggs, their development and early hatchlings or larval stages of *T. tor* (with known parentage) have not so far been described by anybody. The present write-up is intended to fill this lacuna with the help of description of eggs and early developmental stages of *T. tor* grown in one of the Hydel lakes of the Tata Electric Companies at Lonavala, District Pune.

T. tor (Ham.) has not, so far, been reported from any waters south of Tapi river (Tapti); but the fish being largely a herbivorous form (Karamchandani *et al.* 1967) and being good as a sport fish, its fingerlings were brought from River Narmada near Hoshangabad (Madhya Pradesh) in November 1973 and released into Walwhan lake at Lonavala, where they thrived and attained a total length of 540 mm (Standard length 445 mm) and weight of 1.75 kg by July 1978. They were marked by comparatively slim body form, short head and distinctly orange-yellow caudal and other fins, as against the blue coloured caudal, slate coloured other fins and deeper body of *T. khudree*. Efforts were, thereafter, made to breed, *T. tor* by the artificial method of stripping, as was done regularly in the case of *T. khudree* at that lake. On August 23, 1978 a ripe female of almost the same aforesaid length was caught and stripped. It yielded a first batch of 6000 eggs, which were cross-fertilised with milt from a specimen of *T. khudree*. The second effort, after half an hour, yielded only 400 ripe eggs and these were fertilised with milt *T. tor* which was reared in a

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pond in the adjoining farm. Both eggs thrived satisfactorily. Dissection of the female yielded another cluster of 10,800 unripe eggs.

Collection of 17,200 eggs from a female of 540 mm only partially corroborates the estimate of fecundity made by Desai (op. cit) namely 7000 to 1,01,600 eggs from females of size range of 283 to 750 mm in three bursts of spawning. Chaturvedi (1976) estimated fecundity of 78, 340 ova for a fish of 546 mm total length. But in the present case, the first batch of 6400 ripe eggs was laid during stripping and the remaining ones which were unripe, were probably intended for the next spawning bursts as presumed by that author. Moreover, in this case possibility of extrusion and loss of some ripe and oozing eggs at the time of entanglement in the nets before the fish was handled, cannot be ruled out. Further, the size of the fish is outside the size range of 340-380 mm for first maturity; but whether it was second or third spawning, could not be ascertained.

Eggs. The diameter of the eggs immediately on stripping was 2.3 mm and they absorbed comparatively very little water like that of the eggs of *T. khudree;* neverthless on fertilisation and absorption of water, they reached a diameter was 2.8 mm. The colour of the eggs was pale lemon-yellow, and resembled the light coloured egg variety of *T. khudree* (Kulkarni 1971). Possibility of brown or deeper coloured variety of eggs could not, however, be ascertained as eggs of only one female were available. The eggs were heavy, demersal and full of yolk and resembled the eggs of *T. khudree* in all respects except a small difference in diameter, those of the latter being slightly larger (3.2 mm); Desai (op. cit.) mentioned size of ovarian eggs of *T. tor* as varying from 1.0 to 2.22 mm and 'orange coloured'. The variation in size and colour may be due to the fact that they were 'ovarian', i.e. yet to pass through the final stage of maturation necessary for proper fertilisation. The perivitel line space in the fertilised eggs is slightly narrower than in *T. khudree* and is much smaller than found in the case of Catla, Rohu or Mrigal. Other particulars of the embryonic development of the larva within the egg capsule are almost of the same nature as that of *T. khudree* (vide Kulkarni op. cit.) About two hours before hatching out, the tubular heart of the embryo was seen pulsating rhythmically; the blood capsules were also seen in the vessels but they appeared almost colourless. Auditory sacs with otoliths and fully developed eyes were visible but the latter were without much pigment except minute melanic dots on the peripheral ring. Pectoral fin buds were also discernible. The first egg hatched after 76 hours but the remaining eggs started hatching out after 79 to 85 hours; a few lagging behind even up to next day. Leaving aside the extremes, the average hatching period can be said to be 82 hours in water temperature of about 24° C.

Newly hatched larva. The earliest hatchling or the newly hatched larva is 9 mm in total length, with a long prominent yolk sac, a protruding head and a thin inconspicuous tail. The eyes have a clear outline but the pigment is not very dark. Rudiments of mouth can be seen, though the jaws are not clear. The pulsating heart is still visible through the transparent overlapping tissues but the blood corpuscles are only faintly reddish. Some of the blood vessels can be traced even posterior to the yolk sac, right up to the caudal portion. The yolk sac being large and yellow in colour is quite distinctive and measures 5.7 mm in length. It is bilobed, the anterior one being more rounded than the posterior one which is rather narrow in width and elongated as

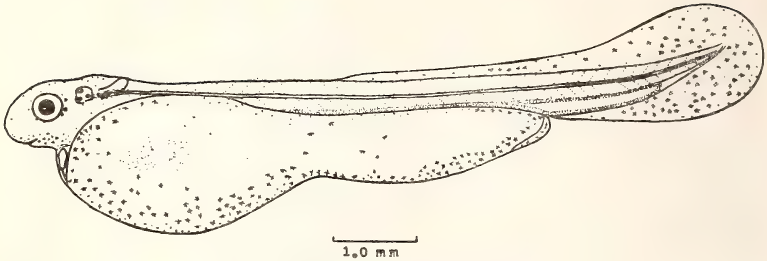

Fig. 1. First day hatching of *T. tor* (Ham.)

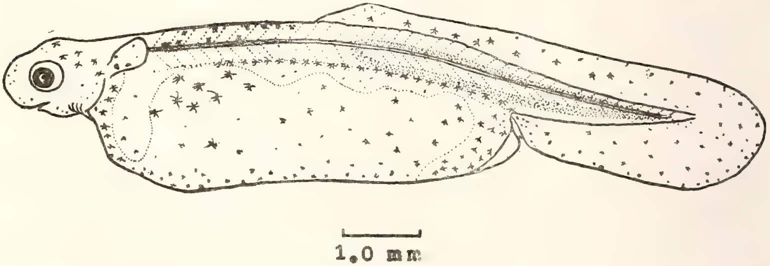

Fig. 2. Two day old hatching of *T. tor* (Ham.)

seen in Fig. 1; but both lobes are almost equal in length. The dorsal finfold starts slightly anterior to the midpoint of the total length, and continues over the caudal end and terminates near the posterior end of the yolk sac at the expected position of the anal opening. The pectoral fin is small and seen fluttering but no finrays are discernible in it.

The larva, though smaller than that of *T. khudree* appears to be more developed than the latter. The myotomes and some blood vessels are clearly seen. The larva, however, manifests the same behaviour of remaining quiescent and lying on its side at the bottom of the hatching tray. It exhibited jerky movements intermittently and vibrated its tail when slightly disturbed.

Two day hatchling: Total length attained 10 mm (Fig. 2). Although the increase in length was nominal, the larva looked much fatter and stouter and continued to remain quiescent, lying on sides and moving vigorously at intervals. The eyes have now become distinctly black with a golden ring when seen in reflected light. Large chromatophores are seen on the anterior portion of the otocyst, yolk sac and at the base of the pectoral fin. A row of elongated pigment specks are lined between the dorsal portion of the body and the yolk sac. These probably mark the position of the future lateral line scales and are continued in the caudal region. Indented or broken outline of the upper internal margin of the yolk sac which is visible provides a clear indication of the yolk being absorbed within the body. In the mouth area, the lower jaws are developed and are seen twitching at intervals. Gill covers are also seen moving slowly. Anal opening and the anal tube are perceptible. The dorsal fin fold shows a small upward growth indicating the position of the dorsal fin but no trace of fin rays either in this fin or the caudal lobe could be seen. A small vertical fin fold on the posterior part of the yolk sac also develops. Even the anal fin lobe has no fin rays. About 25 body myotomes and 15 post-anal myotomes were clearly visible in the reflected light when tissues were alive.

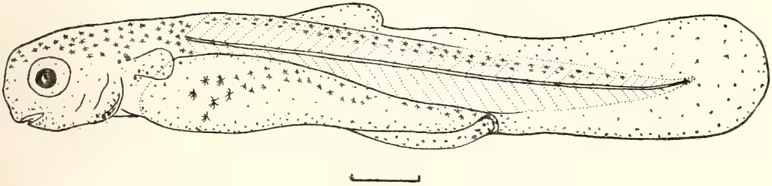

Fig. 3. Three day old hatching of *T. tor* (Ham.)

Three day old hatchling. After three days, i.e. on the fourth day, the larva (Fig. 3) attained a length of only 11.5 mm. The chromatophores at this stage increased all over the body and the head. They are smaller in size but larger in numbers. No finrays are yet discernible in any of the fin lobes. The yolk sac is yet quite prominent but it has changed its outer form by becoming a single continuous sac pointed posteriorly. The finlobe in the pelvic area, i.e. on the posterior part of the yolk sac is reduced in size. The larva which recting its position and trying to swim in normal erect position of a fish but it has still

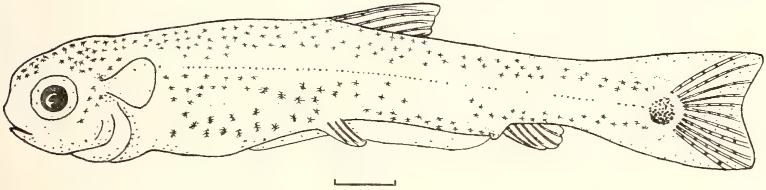

Fig. 4. Ten day old fry of *T. tor* (Ham.)

not reached free swimming stage.

Ten day old hatchling. On the eleventh day, the hatchling has emerged into a tiny fry of about 12.5 mm in total length (fig. 4). The yolk sac has been completely absorbed. Though the length has not increased appreciably during the last five days the development of the external structures has proceeded quite visibly. The body has thickened and the chromatophores have multiplied many fold. They are small on the head, gill cover and the dorsal side of the body all along the length, but large multiradiate chromatophores are seen on the anterior part of the body and below the lateral line. In the caudal region there is a large dark blotch at the base of the caudal fin.

The dorsal fin is clearly demarcated out of the dorsal or the median fin fold, the latter having been completely absorbed up to the caudal lobe where a small vestige remains. In that fin, five rays are seen and the rest are in developing stages. The caudal fin is also demarcated clearly, its terminal end which was rounded in the earlier stage has commenced becoming slightly bifid. Thin fin rays have appeared in the central portion but the growth in the outer fin rays (lower and upper lobes) appears to be affected. The anal fin is also marked out with its fin rays developing. A portion of the fin fold anterior to the anal opening is still persisting and in that region a pair of pelvic fins are making their appearance. The fry at this stage started feeding vigorously on small nauplii of *Artemia* and on small sifted *Moina* and started moving quite actively in the glass tank. However the growth during the last three days appeared to be retarded on account of probable attack of fungus and hence was irregular in some specimens.

Desai (1973) described early stages of *T. tor* out of the collection of post-larvae he made from the open shallow margins of River Narmada. His smallest stage in the collection which he describes as post-larva of *T. tor* measures 8.74 mm whereas the youngest hatchling obtained by me by artificially fertilising the eggs, i.e. where the parentage is known, is 9 mm. The small difference in the total length is negligible and normal but the growth of certain external structures at that length in the case of Desai's early stage, such as demarcation of dorsal fin, the tail becoming forked, yolk sac becoming tapering single lobed and appearance of rudimentary caudal fin rays are not understandable and are not found in the description given here of a 9 mm larva. Development of these structures indicate that his early stage may be a three day old larva, though such larva is 11.5 mm long according to the present observations. As regards myotomes, the number is common in both cases, namely about 40 in each. But his 10.7 mm fry is much more advanced than the 11.5 mm post-larva described here. these differences are hard to explain except the fact that in wild waters where natural stress and competition is high the size of young larvae is smaller than in protected waters.

Fifteen day old fry. After 15 days, the fry was 13.5 mm in length; though it had not progressed noticeably in length, it continued to fatten and looked stouter than before. Even the caudal portion which was thin previously had become thick and prominent with a caudal blotch on it. The chromatophores have become small and thinned out with the result that the fry looked translucent with the development of thin scales. It is olive-white in reflected light. The dorsal fin has eight fin rays, and seven on pelvic fin. The pectoral fin rays have also been developing but only 12 could be counted. The air bladder is seen developing. The vertical fin fold is completely absorbed except at a small portion anterior to the anal opening.

This stage can be compared favourably with that of the 12.5 mm stage of Desai (op. cit.) except that caudal blotch is wider and more prominent in the present observation.

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I am indebted to Tata Electric Companies for affording the necessary facilities for the conduct of the studies covered in this paper, at their Walwhan lake fish farm at Lonavla. I am also grateful to Konkan Krishi Vidyapeeth for the laboratory facilities at the Taraporewala Marine Biological Research Station and especially to Dr. Dileep Jalihal for preparation of drawings and to Shri S. N. Ogale of Tata Electric Companies for general assistance.

REFERENCES

ANONYMOUS (1976): National Commission on Agriculture (Fisheries).

AHMED, NAZIR (1948): On the spawning habits and early development of the Copper mahseer, *Barbus* (*Lissocheilus*) *hexagonolepis* Mclld. *Proc. Nat. Inst. Sci. India* 14: 21-28.

CHATURVEDI, S. K. (1976): Spawning biology of Tor mahseer, *Tor tor* (Ham.). *J. Bombay nat. Hist. Soc. 73*(1): 336-344.

DAVID, A. (1953): Notes on the bionomics and some early stages of the Mahanadi mahseer. *Jour. Asia. Soc. Calcutta 19*: 197-209.

DESAI, V. R. (1970): Studies on the fishery and biology of *Tor tor* (Ham.) from river Narmada. I. food and feeding habits; *J. Inld. Fish. Soc. India 2*: 101-102.

———— (1973): ———, II Maturity, fecundity and larval development; *Proc. Ind. Nat. Sci. Acad. 39*: 228-248.

———— (1972): Notes on the early larval stages of *Tor putitora* (Ham.) *J. Zool. Soc. India. 24* (1): 47-51.

KARAMCHANDANI S. J., DESAI, V. R. & PISOLKAR, M. D. (1967): Biological investigation on the fish and fisheries of the Narmada river. *Bull. Inld. Fish. Res. Inst. 19*: 1-39.

KUIKARNI, C. V. (1971): Spawning habits, eggs and early development of the Deccan Mahseer, *Tor khudree* (Sykes). *J. Bombay nat. Hist. Soc. 67*: 510-521.

TRIPATHI, Y. R. (1978): Artificial breeding of *Tor putitora* (Ham.). J. *Inld. Fish. Soc. Ind. 9*: 161.

FAMILY CYPERACEAE IN KOLHAPUR AND ITS ENVIRONS[1]

A. R. Kulkarni, S. R. Yadav[2] and J. S. Pawar[3]

This note is a continuation of our earlier communications on the flora of Kolhapur and its environs (Kulkarni & Mudgal 1970; Kulkarni 1971, 1974; Kulkarni & Desai 1972, 1974; Kulkarni & Kazi 1973; Thite & Kulkarni 1976 and Kulkarni & Thite 1979) and deals with family Cyperaceae which is represented by eight genera and 52 species according to a conservative estimate. The genera have been arranged in the order followed by Cooke (1908) and species within each genus are arranged alphabetically. Diagnostic characters of the species have been given only in those cases where their existence within Maharashtra has been regarded as doubtful or where there is confusion in the literature about their circumscription.

Kyllinga Rottb., *Pycreus* Beauv., and *Juncellus* Clarke are treated as subgenera of genus *Cyperus* Linn. The genus *Cyperus* comprises 24 out of 52 species reported here. The genus *Fimbristylis* Vahl is represented by 14 species and *Rhynchospora* Vahl, *Scleria* Berg. and *Carex* Linn. by one species each.

Identification of all the species included in this account has been confirmed by referring to the herbarium of Western Circle, BSI, Poona and Blatter herbarium of St. Xavier's College, Bombay. Recent changes in the nomenclature of identified taxa have been followed.

A set of specimens, on which the present account is based, is deposited in the Department of Biological Sciences, Ramnarain Ruia College, Bombay.

Genus **Cyperus** Linn.

Sub-genus *Kyllinga*

CYPERUS BREVIFOLIUS (Rottb.) Hassk. (*Kyllinga brevifolia* Rottb.)

In clayey soil along temporary water courses; University campus, Kolhapur; on the way to Wadanige near Kolhapur; Panhala; June-August.

C. KYLLINGA Endl. (*K. monocephala* Rottb.)

Common in grasslands of Katyayani, Panhala, Malvan, Savantwadi, Amboli; June-November.

C. METGII Hochst. (*K. squamulata* Vahl)

Along lake margin of Kagal near Kolhapur; August-October.

C. TRICEPS (Rottb.) Endl. (*K. triceps* Rottb.)

Fairly common in grasslands of Kolhapur, Kagal, Panhala; June-August.

Sub-genus *Pycreus*

C. ALBOMARGINATUS Mart. and Schrad. ex Nees

(*Pycreus albomarginatus* Nees). Along temporary ponds adjacent to sugarcane fields on Kolhapur-Panhala road; August-October.

C. FLAVESCENS Linn. (*P. flavescens* Linn.)

Plants slender, with filiform stem, leaves and bract; leaves shorter than the stem; bract single, erect; spikelet solitary; nuts with prominent glistening white transverse

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ridges. In meadows of Kolhapur; August-September.

C. GLOBOSUS All. (*P. globosus* All.)
Quite common in clayey mud along temporary water courses and lake margins. Kolhapur—Rankala, Kalamba lakes, University campus; Kagal lake; on way to Wadanige; Panhala, Malvan; July-November.

C. MALABARICUS Clarke (*P. malabaricus* Clarke)
Along streams, Radhanagari; August-October.

C. PUMILUS Linn. (*P. nitens* Nees)
Along marshes of Kagal lake; August-October.

Sub-genus *Juncellus*

C. ALOPECUROIDES Rottb. (*Juncellus alopecuroides* Clarke)
Robust perennial herb. Common in the marshes of ponds and lakes in Kolhapur, Wadanige, Kagal; September-April.

C. PYGMAEUS Rottb. (*J. pygmaeus* Clarke)
Tufted annual with conspicuous globose heads. Rajaram, Rankala and Wadanige lakes of Kolhapur, Kagal lake; June-October.

Sub-genus *Mariscus* Vahl.

C. CYPEROIDES (*Mariscus sieberianus* Nees)
Common in grass-lands of Panhala, Gaganbavada; Vengurla; July-November.

Sub-genus *Cyperus*

CYPERUS ALTERNIFOLIUS Linn.
Ornamental species cultivated in gardens of Kolhapur, Panhala; September-October.

C. ARENARIUS Retz.
Grows in association with *Ipomoea pes-caprae* on the sandy coast of Vengurla. This sand binding sedge is also reported from Konkan by Blatter & McCann (1934) though Cooke (1908) has not reported it from Maharashtra. Stoloniferous; leaves with sheathing base and linear rather fleshy lamina; stem round, green, fleshy and smooth; spikelets in globose heads subtended by 1-3 bracts one of which is erect appearing as if continuous with stem; glumes distichous, concave, membranous; keel 3 nerved, nerves pink; stamens 3; styles 3, pink; nut trigonous, dark-brown, smooth; October-November.

C. ARISTATUS Rottb.
Along the lake margins of Kolhapur, Rankala, Rajaram, Kalamba and Kagal; Bilashi; June-August.

C. COMPRESSUS Linn.
Seasonal, along lake margins, road sides and in rice fields of Kolhapur, Kagal, Panhala and Wadanige; June-October. This species shows distinct ecotypic variations. Populations occupying marshy habitat have robust erect plants, with branched spicate inflorescences. While those found along road sides have creeping habit with less branched inflorescence and smaller spikelets. Road side plants flower earlier than the marsh ones.

C. PANGOREI Rottb.
A robust perennial sedge very common in the marshes near ponds and lakes of Kolhapur, Kagal; August-March.

There appears to be a lot of confusion about circumscription of *C. corymbosus. C. tegetum, C. tegetiformis* and *C. pangorei.* While Cooke (1908) has considered all the three former species as distinct, Blatter & McCann (1934) have merged *C. tegetum* and *C. tegetiformis* with *C. corymbosus* and *C. pangorei* is considered as synonym of *C. tegetum.* Fischer (1928) regards *C. corymbosus* and *C. pangorei* as distinct but *C. tegetum* is considered as synonym of *C. pangorei* and *C. tegetiformis* as synonym of *C. corymbosus.* Kukenthal (1909) also treats *C. pangorei* and *C. corymbosus* as distinct. Our specimens resemble more closely with *C. pangorei* in having lower bracts more than 12.7 cm long and longer than the inflorescence and in some-what remotely arranged scales on the spikelet than with *C. corymbosus* which has bracts upto 1.62 cm long and shorter than the inflorescence and the scales arranged mostly in densely imbricating fashion.

A systematic study of all the four taxa involved is needed to solve this problem.

C. DIFFORMIS Linn.

A seasonal, common in marshy places in Kolhapur; August-October.

C. DISTANS Linn.

Along nala, Gagan-Bavada; September-October.

C. ELUSINOIDES Kunth.

In marshes of Kagal lake near Kolhapur; September-November.

C. IRIA Linn. var. PANICIFORMIS Clarke.

A most common monsoon weed in rice fields and in other marshy situations; June-October.

C. PILOSUS Vahl.

A perennial salt marsh sedge; rhizome stoloniferous covered with scales; spikelets spicately arranged, rather distant on the hispidulous rachis, glumes faint brown, 3 nerved, keel not prominent, lateral sides transparent. Malvan; October.

C. ROTUNDUS Linn.

Prominent in clayey soil along margins of bunds, Kolhapur, Panhala, Gaganbavada, Kagal; June-October.

C. STOLONIFEROUS Retz. In marshes on way to Wadanige; June-October.

Fimbristylis Vahl

F. COMPLANATA Link.

Common in marshes of Kolhapur, Kagal lake, on way to Wadanige; July-September.

F. DICHOTOMA Vahl.

In association with *F. complanata* Vahl. but in more abundance; Kolhapur, Katyayani, Wadanige, Kagal lake; July-March.

F. DIGITATA Boek.

In meadows at Radhanagari in monsoon; August-September. This species has also been collected recently in meadows on Ratnagiri-Pawas road in June.

F. DIPHYLLA Vahl.

In marshes, often in association with *F. dichotoma* Vahl. Katyayani, on way to Wadanige,, Kagal lake, Radhanagari; July-March.

F. FERRUGINEA Vahl.

In marshes of Kolhapur and in salt marshes of Malwan and Ratnagiri; September-February.

F. JUNCIFORMIS Kunth.

In meadows of Kolhapur; June-October.

F. MILIACEA Vahl.

In marshes of Kolhapur, on way to Wadanige; July-September.

F. MONOSTACHYA Hassk.

In meadows; Kolhapur, Panhala; August-October.

F. POLYTRICHOIDES R. Br.

Along the margins of lakes of Kolhapur, and in salt marshes at Malvan; August-October.

F. QUINQUANGULARIS Kunth.

In marshes of Kolhapur; July-September.

F. SPATHACEA Roth.

In salt marshes of Malvan; along nala at Savantwadi; October-December.

F. TENERA Roem and Sch.

Along lake margins, Rankala, Kagal-lake; August-December.

F. TETRAGONA R. Br.

In marshes and lake margins; Kolhapur, Kagal, Radhanagari; July-September. Cooke (1908) and Fischer (1928) have placed this species in dichostylis section of the genus. All the specimens observed by us in field as well as pressed ones show three stigmas. The identification of our material has been checked with reference to the sheets of this species in BSI herbarium of western circle and Blatter herbarium of St. Xavier's College.

F. WOODROWII Clarke.

Occasional, along margins of Kolhapur lakes; June-October.

Eleocharis R. Br.

E. ATROPURPUREA Kunth.

In marshes of lake margins of Kolhapur, Rajaram talao, Rankala talao; July-October.

E. CAPITATA R. Br.

Lake margin of Kagal and salt marshes of Malvan; September to January.

E. PLANTAGINEA R. Br.

Very dominant sedge in lakes of Kolhapur. Rankala, Kagal lake, also in salt marshes of Malvan; August-March.

Scirpus Linn.

S. ARTICULATUS Linn.

In salt marshes of Malvan; October.

S. KYLLINGIOIDES Boeck.

In meadows of Kolhapur; June-August.

This species is being reported for the first time from Maharashtra. Cooke (1908) has remarked that he could not see the specimens of this species from Bombay state. Blatter & McCann (1934, 1935) have recorded it from Canara. Fischer (1928) has not included it in flora of Madras. Shah (1973) has recently described it from Saurashtra. During our recent visit to Ratnagiri we collected it in meadows along Ratnagiri—Pawas road. A brief description of the species based on our specimens, follows

Rhizomatous herbs; rhizome short, erect and thick; stems 4 to 9 cm., solitary or tufted, trigonous and terete. Leaves radicular, lamina with marginal spinules. Inflorescence terminal, of numerous small sessile conjusted white heads, subtended by 3 spreading leaf-like bracts. Spikelets with 8-12, spirally arranged, ovate-lanceolate keeled many nerved glumes. Hypogynous bristles 0. Stamen 1, ovary trigonous, stigmas 3. Nut yellow, obovoid, minutely punctate.

S. LITTORALIS Schrad.

Along marshes of Kagal lake and in salt marshes of Malvan; August-March.

S. MUCRONATUS Linn.

Along Punchaganga river bank; October-May. This species has been excluded from Bombay state by Cooke (1908). Shah (1973) has reported it from Gujarat.

Stems robust, sharply trigonous; leaves reduced to sheaths, heads lateral near the apex of the stem, spikelets sessile, ovate, glumes ovate, acute, keel not prominant; hypogynous bristles 5, barbed with recurved outgrowths, slightly longer than the nut; ovary trigonous, style base not swollen, stigmas 3; nut trigonous, flat on one side and angled on the other, blackish, surface with faint lines.

S. SQUARROSUS Linn.

In hygrophytic situations during monsoon in Kolhapur, Bilashi and Ratnagiri; August-October.

S. SUPINUS Linn.

Common in the marshes of lakes of Kolhapur, Kagal, in marshes of Sangli and Malvan; July-February.

Fuirena Rottb.

F. GLOMERATA Lam.

In salt marshes of Malvan and Vengurla; September-November.

F. WALLICHIANA Kunth.

In the marshes of Kagal lake; August-October.

Rhynchospora Vahl.

R. WIGHTIANA Steud.
In meadows, Malvan; October.

Scleria Berg.

S. STOCKSIANA Boek.
The moist areas around ponds and lakes of Kolhapur; near Dhamapur lake, Malvan; August-October.

Carex Linn.

C. MERCARENSIS Hochst.
As an undergrowth in forests of Gaganbavada, Katyayani; October-February.

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REFERENCES

BLATTER, E. AND MCCANN, C. (1934): Cyperaceae — In the revision of the flora of Bombay Presidency. Part XXIII. *J. Bombay nat. Hist. Soc.* *37* (1): 16-35.

————, (1934): Cyperaceae — In the revision of the flora of Bombay Presidency. Part XXIV. ibid. *37* (2): 254-277.

————, (1934): Cyperaceae — In the revision of the flora of Bombay Presidency. Part XXV. ibid. *37* (3): 532-548.

————, (1935): Cyperaceae — In the revision of the flora of Bombay Presidency. Part XXVI. ibid. *37* (4): 764-779.

————, (1935): Cyperaceae — In the revision of the flora of Bombay Presidency. Part XXVII. ibid. *38* (1): 6-18.

COOKE, T. (1908): The flora of the Presidency of Bombay. Vol. III. Reprinted by Bot. Surv. India, 1958.

FISCHER, C. E. C. (1928): Flora of the Presidency of Madras. Vol. III. Reprinted by Bot. Surv. India, 1957.

KUKENTHAL, G. (1909): Cyperaceae in Engler's Das Pflanzenreich. *38*: 1-824.

KULKARNI, A. R. (1971): Notes on the distribution of *Sesamum mulayanum* Nair in Maharashtra. *J. Bombay nat. Hist. Soc. 68*: 495-96.

————, (1974): *Nicotiana glauca* Grah. — a tree tobacco in Maharashtra. ibid. *71* (2): 340-42.

————, AND DESAI, M. H. (1972): Family Eriocaulaceae in Kolhapur and its environs. ibid. *69*: 231-235.

————, (1974): *Eriocaulon tuberiferum* Kulkarni *et* Desai — A new species from Maharashtra. ibid. *71* (1): 81-84.

———— AND KAZI, M. B. (1972): Contributions to the hydrophytes of Kolhapur — I. Hydrophytes of Kagal lake. *J. Shivaji Univ. 5*: (10) 73-85.

————AND MUDGAL, P. V. (1971): Family Commelinaceae in Kolhapur and its environs. *J. Bombay nat. Hist. Soc. 67*: 616-618.

———— AND THITE, A. N. (1979): Additions to the flora of Kolhapur district. ibid. *74* (Supplement): 592-609.

SHAH, C. K. (1973): The distribution of genus *Scirpus* Linn. in Gujarat. *J. Biol. Sci. 16*: 29-41.

THITE, A. N. AND KULKARNI, A. R. (1976): Fungal flora of Panhala. *J. Bombay nat. Hist. Soc.* *73*(3): 456-468.

A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY—22

Corvidae, Bombycillidae

HUMAYUN ABDULALI

[*Continued from Vol. 75*(2): 384]

This part covers 646 specimens of 71 species and subspecies up to No. 1063 in INDIAN HANDBOOK. I am grateful to Miss Renée Borges and to Mr Shahid Ali for routine assistance for some time.

EL **Platysmurus leucopterus** (Temminck) (Sumatra) Whitewinged Jay **1**:58

1 o? *Tavoy, S. Tenasserim.* Wing 188, tail 180.

EL **Garrulus leucotis leucotis** Hume (Kaukaryit, Tenasserim) Burmese Jay **1**:61

Measurements on p. 94.

3 : 2 ♂♂ 1 ♀

1 *Hsipaw,* 1 *S.E. of Hsipaw,* 1 *Maymyo.*

Measurements on p. 94.

EL **Garrulus glandarius glandarius** (Linnaeus) (Sweden) Jay

2 : 1 ♀ 1 o?. 1 *Godolla,* 1 *Matrajured, Hungary,*

The female has paler blue on the wings and a white chin *contra* almost concolorous with the underparts in the other.

Measurements on p. 94.

EL **Garrulus glandarius haringtoni** Rippon (Mt. Victoria, South Chin Hills) Rippon's Jay. **1**:65

2 ♂♂ : 1 *Camel's Hump, Tiddim,* 1 *Mt. Victoria, Pakokku, Chin Hills.*

Both can be separated from Indian birds by the pale buff, almost white, forehead and their larger wings. Smythies, 1953, BIRDS OF BURMA, p. 9, synonymises *haringtoni* with *G. oatesi* but this is doubtless a slip, for the latter is a subspecies of *G. leucotis.*

Measurements on p. 94.

1020 **Garrulus glandarius bispecularis** Vigors (Himalayan Mts.—Murree) West Himalayan Jay **1**:63

15 : 8 ♂♂ 5 ♀♀ 2 o?

1 Dalhousie, Punjab; 2* Simla; 1 Grikund Kedarnath, 1 Bodiar, 2 Moureakher, Gharwal, 5 Dakuri, Kumaon, 2 Mussoorie, 1 Naini Tal, U.P.

See notes under 1021.

Measurements on p. 94.

1021 **Garrulus glandarius interstinctus** Hartert (Darjeeling) East Himalayan Jay **1**:64

11 : 5 ♂♂ 5 ♀♀ 1 o?

1 Sipuri, 1 Godaveri, 1 Bouzini, all near Khatmandu, Nepal; 1 Shampong, Central Bhutan, 3 Gomchu, 1 Narphong, East Bhutan; 2 Lachung, North Sikkim, 1 *Etalin 8000', Mishmi Hills.*

As has been noted by earlier writers, the two races are not easily separated. In series, the eastern birds are darker but the three from Nepal and one from Mishmi Hills are very reddish above. A ♂ collected at Shampong, 6500 ft. Central Bhutan, has the darkest upperparts and the forehead slightly paler. The birds from Bhutan and Sikkim are not yet registered.

Three males collected in Garhwal (2 on the same day) with pale underparts appear to be birds of the year. Their measurements are not included but are within the range of the adults.

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* One of them bears no locality but was collected by J. C. Anderson.

Vaurie (1959, p. 143) when comparing this with *sinensis* states that the tips of the bristly feathers at the nostril are not black as in the latter. The specimens listed above show a varying amount of black at the tips of feathers at the nostril, and which appears independent of locality.

Measurements on p. 94.

1022 **Garrulus lanceolatus** Vigors (Himalayas—Simla-Almora District) Blackthroated Jay **1**:60

21 : 8 ♂♂ (1 juv.) 8 ♀♀ 5 o?

2 Chitral, 1 Gora Gali; 1 Murree, 1 Dalhousie, 1 Dharmsala, 1 Dhami State, 3 Simla (1 collected by J. C. Anderson?); 2 Moghul Maidan, Kishtwar, Kashmir; 1 Lambathach, 1 Ghat, 1 Boliar, Garhwal, 1 Bininag, 1 Peora, Almora, 2 Morwala, 1 Dakuri, Kumaon, U.P.; 1 no locality.

Juvenile ♂ 291 has the feathers of the chin dishevelled, with short thick streaks, and a brownish head.

The black barring on the central tail feathers varies in distinctness but cannot be associated with sex or locality.

The largest unsexed No. 296 from Dharmsala, Punjab, (Wing 160, tail 165) has the shortest tarsus (28.7). In only one other (♂ 290 from Peora, Almora) is the wing (157) shorter than the tail (159).

Measurements on p. 95.

EL **Cyanocitta cristata** subsp.

1 ♂ *Little Lake, Barrie, Ontario, Canada.*

Wing 135; bill 26.6; tarsus 33; tail 132.

EL **Cyanopica cyanus interposita** Hartert (Tai pai Shan, Tsinling Range, Shensi, China) Azurewinged Magpie

3 ♀♀ *Peking, China.*

These are named trinomially on the basis of distribution in Vaurie (1959) and Peter's CHECK-LIST (1962, 15:245) and the measurements in parenthesis are from La Touche A HANDBOOK OF THE BIRDS OF EASTERN CHINA 2, p. 15. Wing 132, 136, 137 (135-141); bill 26, 26, 28 (24-28.5); tarsus 29, 30.5 (32-36.5), tail 172, 200, 206 (199-230).

1023 **Cissa chinensis chinensis** (Boddaert) (Mergui) Green Magpie **1**:45

18 : 8 ♂♂ 5 ♀♀ 5 o?

2 Ranibag, 1 Kumaon, U.P.; 1 Singhik, N. Sikkim, 1 Singtam, Teesta Valley, 3 Longview T.E.., 1 Darjeeling; 1 Laising, 1 Hungrum, 1 Roopchena, Cachar; 1 Jamirach, Dibrugarh, 2 Margherita, 1 Rotung, Abor Hills; 1 *Mishmi Hills;* 1 *Upper Burma.*

♂ No. 214 from Longview Tea Estate obtained on 25 January 1911 has one whisker on the left 140 mm. long.

15 specimens dated 1902-1952 are varying shades of blue both above and below. Three Nos. 203, 207 and 211 (1 ♂ 1 ♂ juv. 1 o?) from Mishmi Hills, Hungrum and Roopchena, going back to 1904 show a wash of green, particularly on the underparts. All wings are yellowish olive. Stevens (*JBNHS* 29 p. 514) refers to blue examples seen in the wild in March, April and May.

Whistler's mss. notes include a letter from CBT (Ticehurst) asking if the black subterminal bars on the inner secondaries and tertials are less distinct in juveniles, or if it is a racial (Himalayan) character. Only three specimens lack this barring and they are from Laising, N. Cachar ♀, Margherita ♂ and Upper Burma o?. The juvenile ♀ No. 211 is well marked.

Measurements on p. 95.

1024 **Cissa ornata** (Wagler) (Ceylon) Ceylon Blue Magpie

1 ♂ *Rookood, Ceylon.*

Measurements on p. 95.

1025 **Cissa flavirostris cucullata** (Gould) (Kuloo Valley) Western Yellowbilled Blue Magpie **1**:44

10 : 3 ♂♂ (1. juv.) 3 ♀♀ (2 juv.) 4 o? (1 juv.)
1 Doniwani Village, Lolab Valley, 2 Goond, Sind Valley, Kashmir; 1 Zokinath, 1 Chamoli, Garhwal, 4 Dakuri, Kumaon; 1 Kakam, Nepal.

In view of the small number of sexed adults, the measurements do not appear worth detailing.

Sp. No. 201 collected in Goond, Sind Valley, Kashmir, on 8 August 1873 by F. Stoliczka is perhaps one of the oldest specimens in the Bombay collection. One unregistered ♂ from 8000 ft, Chinakotti, West Bhutan, has its bill heavier than in the others and dark above.

See under 1027 for notes on juvenile plumage.

1026 **Cissa flavirostris flavirostris** (Blyth) (Darjeeling) Eastern Yellowbilled Blue Magpie 1:43

5 : 4 ♂♂ (1 juv.) 1 ♀ juv.
3 (1 juv.) Tongloo, 10000′, 1 Phalut 11500′, Darjeeling; 1 Shama Chembo, Rong Valley?

All differ from *C.f. cucullata* in having the lower breast washed with grey ('lilac white') which was presumably once yellow, and the upperparts are slightly darker than in 1025.

Sp. No. 190 from Chembo, Rong Valley, was collected by Stuart Baker on 13 July 1913. The words "Chin Hills" have been added with a query by Sálim Ali many years ago, but this does not appear to be correct, for Stuart Baker (1922, FAUNA, 1, p. 44) states that he had seen only one from Burma and which differed from the normal type (nominate *flavirostris*) in many ways. The latter specimen was collected by Wickham at about 7000 ft. north of Falam (*JBNHS* 33, p. 803) and was no doubt *shaferi* Sick (q.v.).

Four specimens (2 ♂♂ 2 ♀♀) collected in Bhutan by Sálim Ali (1966-68) not yet registered show a much darker grey below. Curiously, in these four specimens, though the males have larger wings (190, 197 cf. 186, 187) the tails are longer in the females (410, 430 cf. 335, 350).

EL **Cissa flavirostris shaferi** Sick (Mt. Victoria, Chin Hills)

1 ♂ *Kennedy Peak, Chin Hills, Burma.*
Wing 172, bill 34, tail 345 (Sp. No. 189).

Shaferi was described on 5 ♂♂ and 9 ♀♀ and the single specimen confirms the small size, and probably represents a good subspecies with a very restricted range.

1027 **Cissa erythrorhyncha occipitalis** (Blyth) (Nepal and to the N.W., as at Mussoorie etc.) Himalayan Redbilled Blue Magpie 1:41

22 : 4 ♂♂ 8 ♀♀ (3 juv.) 10 o? (1 juv.)
1 Patiala State, 1 Dharmi State, 1 Kasumti 6000′, Keonthal, 1 Kufri 8000′, Punjab Hill States; 2 Simla; 1 Dehra Dun, 1 Naini Tal, 1 Lohghat, 1 Gangolihath, Almora; 1 Manauli, 3. Kumaon; 1 Godaveri, 1 Cholna Khel, 4 Loharipowa, Nepal; 2 no data.

Sorting out both the adults and the juveniles of *flavirostris* and *erythrorhyncha* has taken an unexpectedly long time. The red and yellow bills so distinct in the two species in life, both become yellow and I have been unable to trace any description of juvenile *flavirostris*. The collection contains 8 juveniles with the entire top of the head (except for a fringe on the forehead) white, which also extends down the nape. Some were listed as *flavirostris* and others as *erythrorhyncha*. Two juveniles of the above description collected by J. P. Cook at Maymyo has it noted on the original label that the bills were light red in one and scarlet in the other. In the first plumage the bill is black in both species but this noting would link the all-white head with *erythrorhyncha*.

Two others a ♂ and a ♀ from Dakuri, Kumaon, whence 2 adults were also collected, have their crowns sooty black, followed by a broad white patch tapering down on the black of the neck. They agree with Biswas's description of young *erythrorhyncha* (*JBNHS* 60, p. 648), but the adults from the same place are smaller and can be included among the variations in *flavirostris*. The evidence available suggests that this is the juvenile plumage of *flavirostris*, with the white being later reduced to the collar-like band in the adult. Intermediate phases exist, depending to some extent upon the method of preparation of the skin. It is significant that the 3 yellow-billed birds illustrated in Gould's BIRDS OF ASIA and marked *A. flavirostris cucullata* by A. Rutgers in 1969, all have the forecrown black, followed by white extending to the nape.

Psilortinus albicapillus described by Blyth at the same time as *C. flavirostris*, *C. e. occipitalis* and *C. e. magnirostris* (1846, *JASB* 15, p. 27) was admittedly a juvenile and agrees with the juveniles of *erythrorhyncha* above.

As in the case of the previous species, the large proportion of unsexed birds and others in juvenile and intermediate plumage do not make it worthwhile listing the measurements. The bills are no smaller than in *magnirostris*.

1028 **Cissa erythrorhyncha magnirostris** (Blyth) (Ya-Ma-Dong Mountains separating Arracan from Pegu) Burmese Redbilled Blue Magpie **1**:42

8 : 6 ♂♂ (1 juv.) 1 ♀ 1 o? juv.

1 Dimapur, 1 Kanglotomis, Manipur, Assam; 2 *Tiddim, Chin Hills*, 2 *Maymyo*, 1 *Thayetmyo, Burma;* 1 Crawford Market, Bombay, origin?

These birds are slightly darker above but barely separable from *occipitalis* (1027) and certainly do not agree with the original description of *magnirostris*. The bill is not 4-5 mm longer and there is no large bare patch near the eye. The two from Manipur and one from Thayetmyo differ from the Himalayan population in being darker and more suffused with purple-blue on the upperparts, but Hume (*S.F* 6, p. 385) quotes Lt. Ramsay as saying that with large series of both groups, he has seen a specimen of *occipitalis* with plumages in all respects as fine as the best of my Burmese skins". Ramsay also says that though some of the Burmese specimens have enormous bills, others have them as small or smaller than Himalayan birds. He adds that the only constant point of difference between Burmese and Indian birds is in the colouring of the bill(?), feet and irides as pointed out by Hume on Captain Fielden's authority (S.F 3, p. 145), i.e. the legs are scarlet instead of reddish orange of *occipitalis* and the irides are of different shades of brown, but never red. INDIAN HANDBOOK states that irides of *occipitalis* are brown or red-brown and those of *magnirostris* the same'.

Hume (loc. cit.) concludes "....it seems to me very doubtful whether the species (*magnirostris*) can be maintained. What is really wanted is a large and carefully sexed series from Pegu and the Arracan Hills".

1029 **Pica pica bactriana** Bonaparte (Kandahar) Kashmir or Whiterumped Magpie **1**:38

28 : 15 ♂♂ 8 ♀♀ 5 o? (1 juv.)

1 *Sulaimaniyah, Iraq;* 1 *Bagh-e-Jawar* (4 m. S.W. *of Shiraz*), 1 *Baghe Jaffrain*, 1 *Baghe Rezi*, 10 *Shiraz*, 1 *Amirabad, Birjand*, 1 *Neh, Kain, Iran;* 1 *Iggiz Yar, Chinese Turkestan;* 1 Razani, North Baluchistan, 1 Razmak, South Baluchistan, 1 Kelat, 1 Toba, Quetta, 1 Devankot, Baluchistan; 4 Chitral, N.W.F.P.; 2 Ugu 12000′, Indus Valley, Ladakh.

In some specimens, March to May, the rump is greyish, but this character does not appear to be restricted to any age(?) or area. HANDBOOK OF BRITISH BIRDS (1938, 1:28) refers to the rump in nominate *pica* "white or brownish white to brown (in British specimens never very white and often nearly black)".

Measurements on p. 95.

1030 **Pica pica bottanensis** Delessert (Bhutan) Eastern Blackrumped Magpie 1:39

1 o? Wangadi Cholung, Bhumtang Valley, Bhutan.

Together with six additional specimens collected by Sálim Ali at Bhumtang in Bhutan in 1973, but not yet registered, they have a larger wing, a proportionately shorter tail and a black rump, which leave no doubt regarding the validity of this race.

Measurements on p. 95.

EL **Pica pica sericea** Gould (Amoy) Chinese Magpie

5 : 4 ♂♂ (1 juv.) 1 ♀

1 *North Shan States,* 1 *South Shan States,* 1 *Kyatyin-Mogok Road, Ruby Mines District, Burma;* 2 *Peking, China.*

These birds are not very distinct from *bactriana* but the pair from Peking show more blue on the wings and in series there is less white visible above. In the juvenile the black is replaced by brown and there is very little white on the rump.

The tarsus appears longer than in *bactriana* and the tail proportionately shorter. Stuart Baker quotes Gould as having affirmed the former.

Measurements on p. 95.

1031 **Dendrocitta vagabunda pallida** (Blyth) (Galkund, Surat Dangs, Gujarat) Western Tree Pie.

(a) 15: 8 ♂♂ (2 juv.) 4 ♀♀ (1 juv.) 3 o? (2 juv.)

1 Navashar, Jullundur, 3 Ambala; 1 Bahawalpur; 1 Delhi; 1 Bharatpur, Rajasthan; 1 Jacobabad, N. Sind, 1 Khori, 2 Luka, 3 Jah, Tatta, 1 Londi, Karachi.

No. 20347 ♂ from Luka, Tatta is dark rufous below.

(b) 20: 4 ♂♂ (2 juv.) 16 ♀♀ (6 juv.)

1 Hamavas Lake, Pali, Jodhpur; 1 Deesa, Palanpur; 3 Vaghjipur, Mehsana; 1 Hingolgadh, Jasdan, 1 Amreli, 1 Gir, 1 Patan (?), Kathiawar; 2 Victoria Park, Bhavnagar; 1 Cambay City; 1 Galkund, 1 Mheskhatri, 1 Pimpri, Surat Dangs; 3 Suraimal, Thana, 1 Tanda, 1 Kuno, Gwalior.

The type locality of *pallida* has had many vacillations. Blyth described it from a specimen purchased at Calcutta (now the type locality of nominate *vagabunda*) but originally said to have come from the north-western Himalayas (the type locality of *bristoli*). This was restricted by Ticehurt to Simla (1922) and then to Galkund, Surat Dangs, by Paynter who, admitting the possibility of the original description referring to *parvula* from the south-west or *vernayi* from the south and south-eastern India, expressed his reluctance to change the name which had been applied for more than a hundred years. While I agree with his sentiments, I do not know if it is permissible to ignore the original description, though the type locality may be proved or presumed to be wrong. As supporting the original designation of the north-western Himalayas, it may be worth mentioning that *Psilorhynus albocapillus* now *Urocissa erythrorhyncha occipitalis* was described by Blyth from the same collection and this does not occur anywhere except in the Himalayas. Of course, the collection could have included birds from different places.

As explained under *bristoli,* the specimens from the Punjab and Sind appear nearer to *pallida* both in size and colour and are included here, as was done by Paynter. Accepting, however, the type locality as restricted to the Surat Dangs, the northern birds can be separated from the southern topotypical group by their slightly darker upper and lower parts and the fact that the tail/wing ratio is invariably over 160. In this subspecies the first year birds, distinguished from the adults by the white tips to the black non-central tail feathers, show no other differences in colour from the adults.

Measurements on p. 96.

1031a **Dendrocitta vagabunda bristoli** Paynter .(Jabri, c. 11 miles west of Murree, alt. 900 metres, Hazara District, West Pakistan) North Western Tree Pie.

2 ♂♂: 1 2220′ Rawalpindi; 1 2500′ Kalka, Ambala District, Punjab.

Both specimens are outstandingly large and dark and agree with Paynter's original description of *bristoli* (1961, *JBNHS* 58:381) in which he referred to birds from the plains near Ambala and several other places in the Punjab and Sind, as *pallida*. INDIAN HANDBOOK (5, 216) indicates *bristoli* as extending over the whole of the Punjab and Sind and though clines are referred to in the text, birds from the latter places appear much more like *pallida* from Gujarat and I am listing them separately under that race.

In both the specimens, the tails (315,300) are shorter than in the cotypes (334, 342, 363) but this may be due to different methods of measurement, which may also affect the wing/tail ratios.

Measurements on p. 96.

1032 **Dendrocitta vagabunda vagabunda** (Latham) (India, restricted to Calcutta) Northeastern Tree Pie. **1**:48

43 : 25 ♂♂ (12 juv.) 13 ♀♀ (8 juv.) 5 o? (1 juv.)

1 Kudus, Thana; 1 Borivli, 1 Powai, Salsette, Bombay; 1 Khandala; 1 Akibidu, West Goa; 1 Saugor, 2 Chikalda; 1 Ambakona, 1 Jabalpore, 1 Tamia, Chindwara; 2 Wamanpalli, Chanda; 2 Supkar, 1 Sonwani, Balaghat; 1 Bhopalpatnam, 1 Konta, 1 Darbha, 1 Antagarh, 1 Chota Dongar, Bastar; 1 Bhavanipratapur, Kanker; 2 Badrama, Bamra, 1 Keonjhar, 1 Tikerpara, Angul, 1 Raipathar, Phulbani, Orissa; 1 Sankrametta, Vizagapatam District; 1 Partapur, 1 Nepal; 2 Meerut, 1 Bareilly, 1 Pilibhit Terai, U.P.; 1 Madhubani, 1 Baghowni, 1 Saran, Bihar; 1 Nanhati, 24-Parganas, Bengal; 2 Dibrugarh, Assam, 3 *Upper Burma.*

There is considerable diversity in colour and size between individuals which it is not possible to isolate by sex, age or season. The lack of series from any one place prevents any understanding of the sequence of plumages and/or seasonal changes, if any, and it is quite possible that one or more undescribed race may be found within the conglomeration above.

Two young from Wamanpalli, Chanda (No. 21186) and Akibidu, West Goa (No. 23333) have very pale underparts, as in adult *vernayi*, and which is accepted as the first plumage in all races, but the black tail feathers are not tipped white. Another collected at Chanda at the same time (May) is slightly darker, but paler than most other *vagabunda*, and may be closer to *vernayi*.

In series the birds with white tips to the tail feathers (included in juveniles) are slightly paler than the adults but individuals are as dark just as some of the adults are as pale. Among the adults, the five with the darkest underparts are slightly but consistently larger than the others.

The three unsexed skins from Upper Burma show a lot of rufous above and below but can be left in this group both in colour and measurements.

Measurements on p. 96.

1033 **Dendrocitta vagabunda parvula** Whistler & Kinnear (Malabar) Kerala Tree Pie. **1**:48 (Part)

8 : 4 ♂♂ 3 ♀♀ 1 o?

1 Karkala, S. Kanara; 1 Kalladikol, Palghat Gap; 1 Tope, 1 Kodi Motor Road, Palni Hills; 1 Thekaddy, 1 Thattakad, Periyar; 1 Aramboli, 1 Jamestown, Kanyakumari.

These are slightly smaller than *vernayi* and with darker underparts (paler than in *vagabunda*) which show some variation in the small series. The unsexed bird from Karkala, South Kanara, from the accepted range of this subspecies, is exceptionally dark rufous below and has dark upperparts grading into the black of the head. It is marked juvenile and has white tips to the black rectrices and a pale rump. No. 4515, a male from Thekaddy, Periyar lake has underparts as pale as in *vernayi*, but a small 135 mm wing and is presumably in its first plumage.

Measurements on p. 96.

1034 **Dendrocitta vagabunda vernayi** Whistler & Kinnear (Nallamalai Range, 2000′, S. Kurnool) Southeastern Tree Pie 1:48 (Part)

12: 5 ♂♂ 6 ♀♀ 1 o?

1 Chitteri Range, Salem, 1 Edubathi, Billigirirangans; 1 Shevaroy Hills; 2 Palkonda Hills; 1 Nallamalai Hills; 1 Dharwar-Haliyal Road, Mysore, 1 Utnoor, 1 Mananur, 1 Kaulas, 1 Farahabad, S.E. Hyderabad; 1 Pootah, North Arcot.

The northern birds grade into *vagabunda*. The juvenile, in the first plumage, as in the other races, has pale underparts like the adult of this form. There is a wide range of variation in the measurements of the above specimens and this is no doubt due to convergence with *vagabunda* on the north and *parvula* on the west.

Measurements on p. 96.

EL **Dendrocitta vagabunda sclateri** Baker (Mt. Victoria, Chin Hills, Burma) Chin Hills Tree Pie

5: 4 ♀♀ 1 o?

2 *Maymyo;* 1 *Mibauk Village,* 1 *Khayank Chaung, Thayetmyo District;* 1 *Legangyi, Henzada, Burma.*

These birds have very little rufous on the upperparts, the black of the head is not very distinct from the mixed colour of the back and all have pale rumps.

Measurements on p. 96.

1035 **Dendrocitta frontalis frontalis** Horsfield (Assam) Blackbrowed Tree Pie 1:54

4: 2 ♂♂ 2 ♀♀

2 Margherita, 1 Dibrugarh, Assam; 1 *Lonkin (Chindwin Expedition) Upper Burma.*

Wing ♂♂ 130, 132 ♀♀ 124, 128 (IH. ex Baker ♂♀ 120-126) bill 26.3 27, 27.9(2) (*c.* 25); tarsus 24, 25, 27, 27.5 (*c.* 30); tail ♂ 206, 220, ♀ 204, 205 (245-255).

The male from Margherita (No. 273) has the nape and upper back almost white, which portion in the other male (No. 276) is also whiter than the grey in the two females, as well as in two additional females from N.E.-F.A. (Arunachal Pradesh) not yet registered. It is perhaps a sexual difference.

1036 **Dendrocitta leucogaster** Gould (Malabar Coast) Whitebellied Tree Pie 1:51

10: 8 ♂♂ 2 ♀♀

1 Castle Rock, N. Kanara; 1* Berimani, S. Kanara; 1 Wynaad; 1 Parambikolam, Cochin; 3 Thattakad, 1 Promacora, 1 Ponmudi, 1 Thekadi, Travancore.

No. 4520 a male with enlarged gonads (9 × 5 mm) collected at Thattakad differs from all the others in having black edges to the white upper tail-coverts.

Stuart Baker's Fauna referred to the tarsus as "about 30 mm" which is revised in IH 5:225 to "32-34". My measurements agree with the former.

1037 **Dendrocitta formosae occidentalis** Ticehurst (Simla) West Himalayan Tree Pie. 1:52 (Part)

11: 8 ♂♂ (2 juv.) 3 ♀♀ (1 juv.)

7 Simla & Simla Hills; 1 Tara Devi, Keonthal; 1 Phata, Gupta Kashi, Gadhwal; 1 Pithorgarh, 1 Gomai, Almora.

Table of measurements in Note on Validity of *D. f. sarkari*, p. 143 infra.

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* The original label(s) are missing and the entries in both the old (and new) register and the present labels show the locality as "Berimani, South *Konkan*", and I cannot find any place of this name in the postal directory. While it may be a village without a post office, the bird was collected by T. R. Bell who served in Kanara and the district is certainly an error in transcription and should be *Kanara* and not *Konkan*.

1038 **Dendrocitta formosae himalayensis** Blyth (Sikkim) East Himalayan Tree Pie **1**:52

24: 10 ♂♂ 12 ♀♀ 2 o?

1 Hathiban, 1 Bans Bihari, 1 Godavari, Nepal; 1 Majhkali, Ranikhet, 1 Kurseong, 1 Sevoke, Darjeeling; 1 Rinchingpong, W. Sikkim; 2 Dibrugarh, 1 Margherita; 2 Denning, Lohit Valley; 1 Kangpokpi, Manipur; 2 Humgrum, 2 Haflong, N. Cachar, 1 Bagho Bahar, 2 Roopchena, Cachar; 1 *N. Krang, Upper Burma;* 2 south-east of, 1 *Maymyo, Burma.*

The three from Burma have much whiter underparts than the others and, together with many from Assam and eastwards, show more brown than dusky black on their chins.

Peter's CHECK-LIST 15, p. 248 (1962) errs in referring to *D. f. assimilis* Hume from the Andamans.

Table of measurements in Note on Validity of *D. f. sarkari*, p. 143 infra.

1039 **Dendrocitta formosae sarkari** Kinnear & Whistler (Anantgiri, Vizagapatam).

9: 4 ♂♂ 5 ♀♀

2 Anantgiri, Vizagapatam, 1 Jeypore Agency; 5 Berbera, Puri, 1 Mahendragiri, Orissa.

For Note on Validity of this race. (See p. 142.)

1040 **Dendrocitta bayleyi** Tytler (Andamans) Andaman Tree Pie **1**:55

7: 3 ♂♂ 4 ♀♀

4 Wrightmyo, 2 Chirria Tapoo, 1 S. Andamans.

Of 2 females collected at Wrightmyo on 13 February, one has darker underparts and the colours of the head and tail more clearly defined. This had bright yellow irides *contra* greenish yellow in the other, and the former would appear to be a character of maturity.

EL **Crypsirina temea** (Daudin) (Africa, in error for Java) Black Racket-tailed Magpie

2: 1 ♂ 1 ♀

1:56

1 *Kyibin, Henzada,* 1 *Ataran, Amherst, Burma.* Wing ♂♀ 117, 119; bill 25.3, 21.8. The ♂ has a noticeably larger bill.

EL **Crypsirina cucullata** Jerdon (Thayetmyo, Burma) Hooded Racket-tailed Magpie **1**:57

6: 2 ♂ (1 juv.) 4 ♀♀ (2 juv.)

1 *Mungin, Magwe;* 1 *Pyabwe,* 700′, *Yamethin;* 1 *Tarakmaw,* 1 *Kandin,* 1 *Prome,* 1 *Rangoon, Burma.*

♂♀ Wing 102-109; bill 18.3-19.5; tarsus 23.5-25; tail ♂ 162, 165; ♀ 173-175.

The 3 adults have the bill all black, their plumage clear grey, while the younger birds have a yellow patch at the gape and the plumage washed with pinkish.

1041 **Podoces humilis** Hume (Kitchik Yilak-Sinkiang, near Sanju, Yarkand) Hume's Ground Chough **1**:71

2: 1 ♂ 1 ♀

1 *Chusha, Tibet;* 1 *Zunthulpuk,* 16000′, *W. Tibet.*

EL **Podoces ploskei** Zarudny (Alkor, Eastern Iran).

2: 1 ♂ 1 ♀

2 7000′, *Gulugan Plain* 60°*E*×31°N′. *East Iran.* ♂♀ Wing 123, 115; bill 37.5, 32.5; tarsus 44, 37; tail 88, 85.

EL **Podoces hendersoni** Hume (Sinkiang, on the way to Yarkand).

3: 2♀ 1 o? juv.

2 *Opal, 4400′,* 1 *Kashgar, Chinese Turkestan.*

The juvenile is one of the 3 young found in a nest on the ground on 1 May 1931 (C. H. Sherriff). The mother has a longer (46 cf. 42.5 mm) and more massive bill than in the unsexed adult which was registered as *biddulphi.*

EL **Podoces biddulphi** Hume (Maralbashi, Sinkiang).

3: 1♂ 1 ♀ 1 o?

2 *Keriya, 4300′, Karakoram Expedition;* 1 *Chinese Turkestan.*

1042 **Nucifraga caryocatactes multipunctata** Gould (N. W. Himalayas, restricted to

Kashmir, north of the Pir Panjal Range). Larger-spotted Nutcracker 1:67

5 : 3 ♂♂ 2 ♀♀

1 Chitral, 7000′, N.W.F.P.; 1 Yusmarg, 1 Gulmarg, 1 10000′ Ketri, Badrawan, 1 Kashmir.

Measurements on p. 97.

1043 **Nucifraga caryocatactes hemispila** Vigors (Himalayan Mountains, restricted Simla-Almora) Himalayan Nutcracker 1:66 .. (part)

12: 6 ♂♂ 5 ♀♀ 1 o? (fledgling)

2 Nagar, Kulu, Punjab; 4 Koti State, 1 Simla, 1 Bogi, Himalayas ?(), 1 Garhwal, 1 near Tonglu, Darjeeling Division; 2 11000′, Thunsi, Nepal.

Measurements on p. 97.

1044 **Nucifraga caryocatactes macella** Thayer & Bangs (Hsien-Shan-Hsien, 7000′, Hupeh, China) Yunnan Nutcracker 1:66 (part)

3 ♂♂ (1 juv.)

1 Lachen, N. Sikkim; 1 *Etatin, 7000′*, 1 *Yigang Valley, 7500′. Mishmi Hills, Burma.*

Though these cannot be separated from 1043 from the west by the size of, or the number of spots, or any other colour character, the bills are distinctly thicker.

Measurements on p. 97.

EL **Nucifraga caryocatactes rothschildi** Hartert (s. of the Issyk Kul, Russian Turkestan) Tian

1 o? *Bostan Tarek, Chinese Turkestan.*

The white spots are fewer and larger than in both *hemispila* and *macella* above.

1045 **Pyrrhocorax graculus digitatus** Hemprich & Ehrenberg (Syria) Himalayan Yellowbilled or Alpine Chough 1:70

11 : 4 ♂♂ 6 ♀♀ 1 o*? juv.

6 Chitral, N.W.F.P.; 1 Dangail, Kishtwar, Kashmir; 1 Sissoo, 10000′, Lahul; 2 Matari, Niti, Garhwal, 1* collected by S. L. Whymper, probably Garhwal or Kumaon, U.P.

♀ No. 348 from Chitral has its legs and feet black.

Measurements on p. 97.

EL **Pyrrhocorax pyrrhocorax docilis** (Gmelin) (Gilan, N. Iran).

4 : 2 ♂♂ 2 ♀♀

1 *s. of Doneh Pass, Luristan;* 3 *Kidri, 4000′, near Kain, Iran.*

The three from Kidri (1st year birds?) are marked *pontifex* which is now accepted as a synonym of *docilis* (Vaurie). They differ from all the others in having the wings and tails brownish, contrasting sharply with the black of the head, back and rump.

Measurements on p. 97.

1046 **Pyrrhocorax pyrrhocorax centralis** Stresemann (Djarkent, Russian Turkestan) West Himalayan Redbilled Chough 1:68 part)

1 o? Quetta Museum.

The 289 mm wing has narrow primaries, a slightly greenish tinge and the sixth primary 13 mm shorter than the 5th. These characters recur in other forms further east and the specimen is left here on geographical (?) grounds.

Measurements on p. 97.

1047 **Pyrrhocorax pyrrhocorax himalayanus** (Gould) (Himalaya Mountains, restricted to Kumaon) East Himalayan Redbilled Chough 1:68 (part)

6 : 2 ♂♂ 2 ♀♀ 2 o? (1 juv.)

1 Rohtang Pass, 10000′, 1 Kyclang, Lahul; 2 Badrinath, Garhwal, 1 Dakuri, Kumaon; 1 no locality (juv.).

The material available all appears to be from within the accepted range of *himalayanus*. Some show pointed wing quills and there appear to be no specific characters which would separate them from *centralis*. Including the 3 specimens from Bhutan (not yet registered), the largest wing is 310 mm, while Meinertzhagen, when dealing with this race (*Ibis* 1927, p. 372) measures 7 males from

Sikkim and Ladak, 315 to 340 av. 328.

No. 339 a juvenile from the Jones Collection is marked *Pyrrhocorax graculus*.

In INDIAN HANDBOOK (5, p. 242) the bill is said to be "widely variablle 50-100 mm". The last figure if correct must refer to an aberration.

Measurements on p. 97.

EL **Lycocorax pyrrhopterus pyrrhopterus** (Bonaparte) (Gilolo, Northern Moluccas)

1 *Halmahera, Northern Moluccas.*

EL **Corvus dauuricus** Pallas (circa Baikalem)

2 : 1 ♂ 1 ♀ *Peking, China* (Nos. 130 & 131)

EL **Corvus torquatus** Lesson (China)

3 : 2 ♂♂ 1 ♀

3 *Temple of Heaven, Peking.*

1048 **Corvus splendens zugmayeri** Laubmann (Las Belas, Baluchistan) Sind House Crow **1**:34

33 : 19 ♂♂ 11 ♀♀ 3 o?

3 Rawalpindi, N.W.F.P.; 1 Dharmi State, 5000', N.W. Himalayas, 1 Gunderbal, near Srinagar, Kashmir*, 1 Jullunder, 1 Multan, 1 Mubarikpur, 3 Ambala; 1 Dadil, 2 Sehwan, Larkana; 2 Bhung, Bahawalpur, 3 Mewashah, 1 Korangin, 1 Dhakeri, 1 Dakejee, Karachi, Sind; 2 Bikanir, 2 Pirotan, Gulf of Kutch, 2 Mandvi, 1 Tapkeshwari, Bhuj; 1 Dwarka, Okhamandal, 2 Hingolgad, Jasden, Kathiawar, 1 Radhanpur, North Gujarat.

Ticehurst (1922, *Ibis*, p. 536) said "The Sind race differs from the typical one in having a much paler collar and underparts (as Hume noted), pale smoke grey in fresh feather, creamy grey or dirty white in worn dress". Young birds are darker than the adults.

As in nominate *splendens* (q.v.) there is some variation in the shade of grey on the neck. Of the three from Rawalpindi (all February) the two males are pale, while the female could be matched with many from Peninsular India. Similarly, the four from Ambala district are a little darker and intermediate between nominate *splendens* and *zugmayeri*. All 12 (8 ♂♂ 4 ♀♀) collected between 26 April and 13 October have worn feathers round the neck, which show collars of sandy or dirty white in varying shades, quite different from that attained by nominate *splendens*. Accepting this as a racial character, the specimens from Pirotan in the Gulf of Kutch, Kutch and Saurashtra, all agree with *zugmayeri*, though Sálim Ali has specifically held that this race does not occur south of the Rann, and identified the Kutch birds (also one from Larkana, Sind) as of the nominate form. Birds from Larkana and Bhung, Bahawalpur, have the palest collars. Of the two females from Mandvi, Kutch, one agrees with *zugmayeri* and the other with nominate *splendens*.

The four from Jullunder (1), Multan (1) and Bikanir (2), are albinoids in varying phases of grey and brown, and are included here on geographical grounds. The two from Bikanir were obtained in 1913 and 1940.

Measurements on p. 98.

1049 **Corvus splendens splendens** Vieillot (Bengal) Indian Hovse Crow **1**:33

35: 16 ♂♂ (2 juv.) 12 ♀♀ (2 juv.) 7 o? (1 head only, 1 pure, 1 partial albino, 1 isabelline).

1 Bharatpur, 1 Meerut; 1 Jalar, Jodhpur; 1 Gir, Amreli; 5 Bandra, 1 Andheri, 9 Bombay; 2 Kihim, Kolaba; 2 Nagpur; 1 Ulavi, 1 Kambally Kopa, Sagar, Mysore; 1 Edanad, Chengamner, 1 Jamestown, Kanyakumari; 1 Vyampapti, Trichinopoly, 1 Karumbapatti, Salem; 1 Bhopalapatnam, Bastar; 1 Bhagowni, 1 Darbhanga, Bihar; 1 Calcutta; 2 no locality.

Reference has already been made to the appreciable variations in colour in *zugmayeri* and it is no less in this subspecies. ♂ No. 90 from Vyampapti, Trichinopoly, (9 July) has a grey neck as pale as others listed as *zugmayeri*, but the nature of the worn grey feathers in the latter is distinctive and I would prefer to leave the birds from the Gulf of Kutch and the northern and western coasts of Kathiawar with them. A single ♂ (No. 19789 dated 15 March) from the Gir, in southern Kathiawar, appears to be nominate *splendens*. Some additional specimens of this common species from different parts of Kathiawar, Gujarat, Rajasthan, Delhi, etc., are necessary to permit more certain decisions regarding the determination of the limits of the two subspecies.

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* Whistler (JB 29:160) referred to an isolated colony in the Kashmir Valley and Ticehurst (JB 31: 692) states that its occurrence at Muscat in Arabia must be due to introduction.

Measurements on p. 98.

1050 **Corvus splendens protegatus** Madarasz (Mt. Lavinia, W.P., Ceylon) Ceylon House Crow 1:35

3: 1 ♂ 2 ♀♀

1 Colombo, 2 Ceylon.

Birds from Kerala are said to be of this subspecies but I would prefer to leave the material available among the variations in nominate *splendens* which does become a little darker in the southwest.

Ceylon birds the colour of the hindneck grades almost imperceptibly into that of the back, but the line of demarcation is distinct in Indian birds.

Measurements on p. 98.

1051 **Corvus splendens maledivicus** Reichenow (Maldives).

nil.

EL **Corvus splendens insolens** Hume (Tenasserim) Burmese House Crow 1:34

8: 4 ♂♂ (1 juv.) 4 ♀♀ (1 juv.)

2 *Maymyo;* 6 *Prome, Lower Burma.*

The adults show no trace of a pale collar. The three adult females, all taken on 8 March 1929, are duller than the males. Both juveniles, though fully feathered, are browner than the adults.

1052 **Corvus frugilegus frugilegus** Linnaeus (Sweden) Rook 1:14

14: 5 ♂♂ (2 imm.*) 4 ♀♀ (2 imm.) o? 5 (3 imm.) * with nasal bristles

2 *Sheikh Saad,* 2 *Shatt-al-Adhain, River Tigris,* 1 *Samarra,* 1 *Baghdad,* 2 *Mesopotamia;* 2 *Meshed, 3000′,* 1 *Amirabad, near Birjand, Iran;* 2 Rawalpindi; N.W.F.P.; 1 Jhelum, Punjab.

Though Hartert's *tschusii* is no longer accepted, the last three from Pakistan have noticeably narrower and longer (♂ 63.5 cf. 53.5-62 av. 57.7; ♀♀ 60, 61 cf. 54, 57.1 in 2 imm.) bills, the main characters on which this was separated (type locality Gilgit).

EL **Corvus frugilegus pastinator** Gould (Chusan, China).

1 ♂ *Temple of Heaven, Peking.*

Wing 329; bill 60.7; tarsus 49.5; tail 190.

1053 **Corvus monedula monedula** Linnaeus (Sweden) Jackdaw 1:36

8: 6 ♂♂ (1 juv.) 1 ♀ juv. 1 o? juv.

1 *Baghdad, Mesopotamia;* 2 Chitral, 2 Peshawar, N.W.F.P.; 1 Srinagar, 1 Kashmir Valley, 1 Kashmere.

Fischer's *soemmeringi* from Moscow, though accepted in Peter's *Check-list* (1962), is not recognised in INDIAN HANDBOOK.

The bird from Baghdad has the smallest wing and bill.

Measurements on p. 97.

1054 **Corvus macrorhynchos intermedius** Adams (Kashmir, Dagshai, and Simla, restricted to Kashmir) Himalayan Jungle Crow. 1:28

26: 18 ♂♂ 6 ♀♀ 2 o?

1 Khalid Drosh, 2 Chitral, N.W.F.P.; 1 Marge, above Kongan, Sind Valley, 1 Wulur Lake, 2 Lidar Valley 9500′, 1 Gilgit, Kashmir; 1 Keonthal, 1 Koti, 8 Simla; 6 Mussoorie, 1 Darjeeling 5500′, U.P.; 1 no data (A. E. Jones Collection No. 14).

Except for 3 ♂♂ Nos. 38 Gilgit, 39 and 44 Lidar Valley, and 1 ♀ No. 15642 Simla, all the others have white bases to the feathers of the nape. No. 44 from Lidar Valley has brown underparts. The bill illustrated in INDIAN HANDBOOK (5, p. 252) is larger than in any specimen available.

Measurements on p. 98.

1055 **Corvus macrorhynchos levaillanti** Lesson (Bengal) Eastern Jungle Crow. 1:2

8 : 4 ♂♂ 2 ♀♀ 2 o?

1 Bourini, 1 Godavery, Nepal; 1 *Gangtok, Sikkim; 1 *Tezu, Lohit Valley, Assam; 1 *Tiddim, Chin Hills*, 1 *s.-e. Maymyo*, 1 **Kyithe, Prome;* 1 **Legongyi, Henzada, Burma.*

No topotypes are available and these birds separated on geographical groups are not distinctly separable from *intermedius*. The deeply bowed-bill is visible only in four (2 ♀♀ 2 o?) marked with an asterisk, but 6 males (no female) of *intermedius* from Mussoorie, Simla and Gilgit share this character.

All the birds from Chitral, Kashmir and Simla, have their tail-wing ratio over 60 (upto 67), while those from Mussoorie and eastwards average under 60%. The relatively longer tail appears to be a consistent feature of the western birds separating them from all the other races referred to here. Except in Nos. 37 Gangtok and 55 Tiddim, Chin Hills, the nape feathers are grey.

Measurements on p. 98.

1055a **Corvus macrorhynchos andamanensis** Tytler = Beavan (Port Blair, Andamans) Andaman Jungle Crow.

7 : 4 ♂♂ 2 ♀♀ 1 o?

1 Middle Button I., 2 Wrightmyo, 4 Port Blair. South Andamans.

The nape feathers, as in *levaillantii*, are both grey or white and the measurements of the wing and tail can be included with them; but the bills are much heavier (the largest ♂ 65.5 not deeply bowed) which, together with the plaintive and less harsh call (see *JBNHS* 61, p. 555), appear to be sufficient to retain the island race.

Measurements on p. 98.

1056 **Corvus macrorhynchos tibetosinensis** Kleinschmidt & Wiegold (South-east Tibet in the Sifan Region) Tibetan Jungle Crow.

2 : 1 ♂ 1 o?

1 Sadiya, Upper Assam; 1 no data.

The Sadiya bird has an enormous bill, and is marked *tibetosinensis* by Sálim Ali, who (*JBNHS* 48, p. 36/7) refers to this race other specimens taken in the area including ♀ 4513 taken at Tezu, Lohit Valley. This specimen has a small 297 mm wing and I have left it under *levaillantii*.

The second bird with no data was listed with *Corvus corone orientalis* but the bristles over the nostrils are not coarse and stiff as in that species.

Much of the literature relating to earlier work on this species is not available in Bombay, and the whole group needs re-examination.

Measurements on p. 98.

1057 **Corvus macrorhynchos culminatus** Sykes (Dukkun = Poona) Indian Jungle Crow.

34: 11 ♂♂ 17 ♀♀ 6 o?

2 Karnal, 3 Ambala, Punjab; 1 Gir, 1 Ajwa, Baroda; 1 Thana, 1 Malad, 1 Bandra, 3 Mahim, 2 Bombay; 1 Kihim, Alibag, Kolaba; 2 Khandala, 1 Khangaon, Dhond, Poona; 1 Santgal, North Kanara; 2 Hikkeri, 1 Khambikoppa, Sagar, 1 Honametti 5000′, Mysore; 2 Patton, Trivandrum, Kerala; 2 Chitteri Range, Salem, Tamil Nadu; 1 Raipur tal, Nellore, A.P.; 1 Gondia, 2 Darbha, Bastar, M.P.; 1 Kanpur, U.P.; 1 ?

These are the darkest black. Female No. 32 from Honametti 5000′, Mysore, has the largest wing (315), bill (62) and tail (185), while the tail-wing ratio remains under 60 (58.7%).

Measurements on p. 98.

EL **Corvus macrorhynchos colonorum** Swinhoe (northeastern Formosa).

1 ♀ Peking, China.

This is very dull coloured, but was collected in 1900.

1058 **Corvus corone orientalis** Eversmann (Naryu R., Turkestan) Eastern Carrion Crow. **1**:24

4 : 3 ♂♂ 1 ♀

1 *Kashgar, China;* 2 Ugu Nulla 14000′, 1 Moulbekh, Ladakh.

The last bird collected on 3 August 1976 has the 3 outer primaries and most of the secondaries brown, the others black. The feathers of the head and body are mostly brown, with occasional black ones showing through. The tail is incomplete and in heavy moult. Sálim Ali and S. A. Hussain who obtained it noted others completely black in the same area.

Measurements on p. 99.

1058a **Corvus corone sharpii** Oates (Mardan, Punjab) Eastern Hooded Crow. **1**:32

10 : 7 ♂♂ 2 ♀♀ 1 o?

1 *Amara,* 1 *Baghdad, Mesopotamia;* 1 *Teheran,* 3 *Shiraz,* 1 *Birjand,* 3 *Meshed, Iran.*

No. 76, Teheran, is a juvenile female with a yellow bill, *contra* black in all the others.

Measurements on p. 99.

EL **Corvus corone capellinus** Sclater (Fao, Southern Iraq)

8 : 1 ♂ 3 ♀♀ 4 o?

1 *Lake Akkakurf, near Baghdad,* 1 *Mohammarah,* 1 *Amara,* 2 *Basra,* 2 *Mesopotamia;* 1 *Persian Gulf.*

Measurements on p. 99.

EL **Corvus corone cornix** Linnaeus Hooded Crow

1 ♀ *Mohses, Hungary.*

The bill is appreciably shorter than in the other races.

Measurements on p. 99.

1059 **Corvus corax subcorax** Severtzov (N.W. & S.E. Turkestan) Punjab Raven

15 : 5 ♂♂ 7 ♀♀ 3 o?

1 *Sheik Saad, Iraq;* 2 *Amirabad,* 2 *Birjand, E. Persia;* 1 Chaman, 1 Quetta, Baluchistan; 1 Razani, Waziristan; 1 Rawalpindi, N.W.F.P.; 1 Chaurkana, Gujranwala, 1 Yahore, Punjab; 1 Bahawalpur; 1 Jacobabad, Upper Sind; 1 Pichial Lake, Jodhpur; 1 Ping Bet, Little Rann, Kutch.

Some with short wings (396-412) including individuals with a brown wash on the head and other parts of the plumage were marked *ruficollis,* but if the wing measurements are considered along with those of the tail and the height of the bill, and the fact that young *subcorax* are brown, they appear to agree more closely with the latter rather than *ruficollis.*

While the wing and tail measurements of *subcorax* and *tibetanus* do not overlap, some of the former have very massive bills.

Measurements on p. 99.

1060 **Corvus corax tibetanus** Hodgson (Tibet) Tibet Raven **1**:23

3 : 2 ♂♂ 1 ♀

1 Tso Morari Lake, 2 Ladakh.

While this is larger and with long neck hackles, the latter does not appear to be an infallible character for separating it from *subcorax,* some of which have them long. The last bird (1977) from Tso Morari is jet black, and is outstandingly different from all the others, which have probably faded.

Measurements on p. 99.

1061 **Corvus corax ruficollis** Lesson (Cape Verde Is.) Brown-necked Raven 1:23

10: 1 ♂ 7 ♀♀ 2 o?

4 *Amirabad,* 2 *Birjand, E. Persia;* 1 *Persian Baluchistan,* 1 *Chabar, Persian Gulf;* 1 *Nasirabad, 24 miles west of Turbat, Mekran;* 1 Panjgur, Baluchistan.

Both *ruficollis* and *subcorax* have been taken at the same places in eastern Persia, and a reference to the specimens shows that a brown tinge on the upperparts and/or breast need not necessarily identify *ruficollis.* The wing range in the material identified is appreciably lower than in *subcorax*, and the depth of the bill and the length of the tail are also exclusive.

The short neck hackles, the brown of the head and the measurements all appear to separate this from *subcorax* (*supra*).

Vaurie (1954) held that *ruficollis* was not a subspecies of *Corvus corax* but a separate species. The evidence available certainly supports this view.

Measurements on p. 99.

1062 **Bombycilla garrulus garrulus** (Linnaeus) (Sweden) Waxwing **3**:23

3 ♀♀ *Temple of Heaven, Paking, China.*

The bills are longer and the tails shorter than in both Witherby's HANDBOOK and Stuart Baker's FAUNA. If Poljokov's *centralasiae* (1915, Zansan District and Smeinogorsk, Southwestern Altai) is separable, the present specimens would distributionally be of this race.

Measurements on p. 99.

1063 **Hypocolius ampelinus** Bonaparte (NE. Africa) Grey Hypocolius **1**:357

17 : 6 ♂♂ 5 ♀♀ 6 o?

4 *Sera, Tigris,* 4 *Shatt-al-Adhain,* 1 *Zad,* 3 *Baghdad,* 1 *Garradah,* 1 *Bushire, Mesopotamia,* 2 Kuar Bett, Kutch; 1 Kihim, Kolaba district, Bombay.

The males show the following variations among themselves which it is not possible to associate with age, season or any other factor:

(a) Two from Garradah (?) and Bushire (14 April) have pale, almost cream-coloured heads, while the two from India, 14 November, Kihim, and 23rd March, Kuar Bett, Kutch, have the head grey, darker than the back, as in the remainder.

(b) Two have black bills, while the others are largely yellow (originally horny) with black tips.

(c) The white patch at the tip of the wing is pure white only in two, the others being sullied by a varying amount of brown.

The females are a pale brown all over with darkening tips to the tail. None of them show their primaries with "black terminal ends and white tips" as per INDIAN HANDBOOK 5, p. 269.

Meinertzhagen (*Ibis,* 1947, p. 666) refers to "juvenile females being like the adult females, but slightly more isabelline, and the juvenile male being similar but with greyish white tips to the wing feathers". Some of the unsexed birds mentioned above may be young males, but of the three with pale tips to the primaries, one is a reliably sexed ♀ from Kutch.

Measurements on p. 99.

Measurements

EL. **Garrulus leucotis leucotis** Hume

	Wing	Bill	Tarsus	Tail
♂♀	170, 179, 180	30.6, 32, 33	32.8, 37.2, 40	128, 129, 131
	(165-177	*c.* 26	*c.* 45	*c.* 130)

1020-1021 *et al.* **Garrulus glandarius** subspp.

nominate ♂♀	180, 184	29, 30.5	31.5, 35.2	140, 141
(BR. HAND. ♂♀	174-195	from skull 28-39	39-44	140-152)
haringtoni ♂♂ (2)	177, 177,	31, 31.7	40, 43	138 (2)
	(170-178	—	—	—)
bispecularis ♂♂ (8)	161-172 av. 166.5	27.8-29.6 av. 28.8	35-39.5 av. 37.4	144-150 av. 147.8
	(♂♀ 160-178	*c.* 26	*c.* 32	*c.* 180)
(10 ♂♂ Central Nepal measured by Biswas and quoted in IND. HAND. 5:20, Wing 142-153)				
interstinctus ♂♂ (5)	157-171 av. 166	28.5-30 av. 29	34.7-42 av. 38	130-153 av. 146
bispecularis ♀♀ (5)	170, 172, 173	27.5, 28, 29.5	34, 35, 38	144, 152, 158
interstinctus ♀♀ (5)	162-172 av. 167	28.2-30.8 av. 29.7	36.3-38.6 av. 37.3	141-149 av. 144
	(IH ♂♀ 160-170	from skull 29-32	38-43	142-156)

1022 **Garrulus lanceolatus**

	Wing	Bill	Tarsus	Tail
♂♂ (7)	143-157 av. 151.7	22.7-26.5 av. 24.1	28.7-36.2 av. 32.8	133-159 av. **145**
♀♀ (8)	151-157 av. 153.6	23.5-25 av. 24.2	31.8-36 av. 33.8	139-154 av. 144
	(IH ♂♀ 144-158	from skull *c.* 28	—	141-169 *ex* Paludin, Biswas)

1023 **Cissa chinensis chinensis**

	Wing	Bill	Tarsus	Tail
♂♂ (8)	141-154 av. 148.3	30.6-38.7 av. 35.4	34.5, 38-44 av. 40.4	173-212 av. 192
	(IH 137-157	from skull 37-42	46-47	193-210)
♀♀ (5)	142, 145, 146, 148	34(3), 36.4	39, 40.7(2), 42.5	186, 192, 193, 207
	(IH 138-155	34-39	43-44	171-210)

1024 **Cissa ornata**

	Wing	Bill	Tarsus	Tail
♂	170	38.7	41	185 +
	(♂♀ 155-170	*c.* 37	*c.* 40	235-255)

1029, 1030 *et al.* **Pica pica** subspp.

		Wing	Bill	Tarsus	Tail	Tail/Wing Ratio
1029	*bactriana* ♂♂ (15)	**190-215** av. 205	35.5-41 av. 36.6	42.4-49 av. 45.5	195-286 av. 253	98.5, 114-136 av. 125
,,	♀♀ (8)	188-219 av. 205	31.4-32 av. 35.6	37-52.7 av. 42.5	225-266 av. 252	121-136 av. 124.5
	(♂♀	182-227 mostly over 200	30-32	40-45	200-270)	
1030	*bottanensis*					
	♂♂	245, 246	38.5, 39	52, 56	240, 250	101.6 (2)
	♀♀	234, 239	36, 37	51, 52	225, 237	99, 101.2
	o?	235(2), 239	38, 39 (2)	49.5, 50, 52	232, 235, 240	98.7, 100, 100.4
	(IH 35 ♂♀	224-268 *ex* Vaurie,	Kinnear)			
EL	***P. p. sericea*** ♂♂	208, 216, 217	35, 36.5, 37	43, 46.5, 50	230, 243, 260	110,5, 112, 120
	♀	205	33.7	43	255	124

1031-1034 *et al.* **Dendrocitta vagabunda** subspp.

	♂♂	Wing	Bill	Tarsus	Tail	Tail/Wing Ratio
1031a	*bristoli* (2)	173, 175	30, 28.3	37.5, 32.5	315, 300	182, 171
	(Paynter	157-179 av. 169.9	—		265-363 av. 312.6)	
1031	*pallida* (a) (6)	157-165 av. 161	29.9-31 av. 30	27.5-32 av. 31	257-271 av. 256	162-169 av. 165
	pallida (b) (2)	152, 159	27.7, 30	30.5, 31.5	220, 242	145, 152
	juvenile* (2)	142, 165	27	28	261	158
	(Paynter a & b	149-172 av. 153.5	—	—	217.5-297)	
1032	*vagabunda*					
	dark below (5)	149-168 av. 158	29-31.5 av. 30.2	28.5-32.5 av. 30.2	230-268 av. 250	av. 153
	pale below (7)	145-159 av. 152	27.6-31.3 av. 29.8	25-35 av. 28	202-249 av. 238	av. 156.5
	juvenile (10)	143-158 av. 150.3	28-31.2 av. 29.4	26.5-32 av. 29.7	196-242 av. 223.6	av. 149
1033	*parvula* (3)	135, 142, 144	28.8, 29, 30.2	26.6, 27.5, 28	206	141
1034	*vernayi* (4)	145, 147, 149, 153	28.7-30.3 av. 29.2	28.6-32.7 av. 29.6	183, 212, 220	av. 140
	♀♀					
1031a	*bristoli*	—	—	—	—	—
	(Paynter	158-174 av. 163.8	—	—	269-349 av. 304)	
1031	*pallida* (a) (3)	157-167 av. 161	28.5-30.5	29-32.5	246-270 av. 255	153, 159-168 av. 161
	*pallida** (b) (8)	144-162 av. 152.5	26.4-31 av. 28	27-31 av. 29.3	216-266 av. 238	146-164 av. 156
	juvenile* (6)	145-159 av. 151	26.5, 28.5	30, 30	215-242 av. 225	av. 149
	(Paynter a & b	144-165 av. 153.5	—	—	219-279 av. 243.7)	
1032	*vagabunda*	142-160 av. 154	27.6-30 av. 28.8	28.2-32 av. 29.6	210-269 av. 237.6	av. 154
	juvenile	143, 144, 147, 148	26-28	28.5-31	214-225 av. 218.5	av. 150
1033	*parvula* (3)	132, 141, 143	27, 27.5, 27.7	25.5, 26.5, 29	198, 202, 203	av. 145
1034	*vernayi* (7)	138-147	26.8-28 av. 27.9	26-32 av. 28.2	133-212 av. 182	av. 124
EL	*sclateri* (4)	150-158 av. 153	27-30.5 av. 29.2	30.5-31 av. 30.6	230-252 av. 240	av. 157

* With white tips to black tail feathers.

1042-1044 **Nucifraga caryocatactes** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1042 *multipunctata* (3)	202, 207, 211	36, 45.3, 47.5	34, 36.5, 38	148, 150, 152
1043 *hemispila* (6)	209-220 (213)	44.5-46.6 (45.9)	37.5-40.5 (39)	132-150 (137.6)
1044 *macella* (2)	212, 215	43.8, 45	37, 40	143, 135
♀♀				
1042 *multipunctata* (2)	206, 207	47, 49.7	35.3, 37.6	152
1043 *hemispila* (4)	207-209	45-48	35.5-39.2	131-149 (138)
o? *rothschildi*	193	47	34	132

1045 **Pyrrhocorax graculus digitatus**

♂♂ (4)	263, 281, 283, 286	33.2-35	36-45	162, 171, 175, 182
(IH	274-298	from skull 34-38	42-48	174-193)
♀♀ (6)	254-280	31.5-34	35-38	155-171
(IH	262-273	from skull 32-36	41-46	165-178)

Etchecopar in LES OISEAUX DU MOYEN ORIENT. p.532, states that this race is larger than the nominate with the wings 280-289 mm. *contra* 255-279.

1046, 1047 *et al.* **Pyrrhocorax pyrrhocorax** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
docilis (2)	289, 298	51.8, 54.5	45.5, 49	145, 147
1047 *himalayanus* (4)	298-310 av. 307	49.5-65 av. 56.3	46-57	150-160 av. 154
♀♀				
docilis (2)	273, 282	50, 50.5	45, 47.5	133, 135
1046 *centralis* (IH ♂♀	290-336 mostly over 310	from skull 50-56	50-58	—)
1047 *himalayanus* (3)	296, 301 (2)	50.7, 52, 52.3	46,50, 51	152, 153, 163
(IH ♂♀	291-332	50-103 widely variable	55-65	—)

1053 **Corvus monedula monedula**

♂♂ (6)	233-253 av. 24.1	32-37.5 av. 34.5	37.5-45	132-146 av. 138
(IH ♂♀	230-250	32-34	*c.* 44	*c.* 135)

1048-1050 *et al.* **Corvus splendens** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1048 *zugmayeri* (19)	252-289 av. 272	44-52 av. 49	41-49 av. 44	150-175 av. 164
	(IH ♂♀ 255-290 ex CBT)			
1049 *splendens* (14)	246-278 av. 266	47.5-52.5 av. 5.2	38.5-46 av. 42.8	145-173 av. 160
	(IH 266-284	from skull 51-56	45-51	162-175)
1050 *protegatus*	250	45.5	44	145
	(IH 255-284	from skull 49-55	45-48	147-169)
EL *insolens* (3)	245-255	49.1-51	42-42.5	140, 141, 150
♀♀				
1048 *zugmayeri* (11)	240-278 av. 261	44-51 av. 46.5	39.5-45 av. 42	150-175 av. 158.8
	(IH ♂♀ 255-290 *ex* CBT)			
1049 *splendens* (10)	256-279 av. 265	45-52 av. 48.2	39-46 av. 42.4	154-164 av. 157.3
	(IH 252-282	from skull 45-50	44-48	154-175)
1050 *protegatus* (2)	241, 252	42.1, 46.5	38.6, 45.5	138, 150
	(IH 219-264	from skull 42-50	45-48	128-155)
EL *insolens* (3)	239, 244, 248	48.2-50	41-43	134, 142, 144

In *zugmayeri,* young birds are darker than adults, and in the material available the males measure larger than the females.

1054-1057 *et al.* **Corvus macrorhynchos** subspp.

	Wing	Bill	Tail	Tail/Wing ratio (average)
♂♂				
1054 *intermedius* (18)	293*, 304-362 av. 331	56.5-63.5 av. 58.5	166*, 181-225 av. 200.3	61.3
	(IH 311-378	from skull 54-73	144-242)	
		(* albinoid with horn-coloured bill)		
1055 *levailantii* (4)	286-330 av. 309	57.5-61.5 av. 60.5	165-193 av. 182	58.8
	(IH 308-335	from skull 61-69	181-197)	
1055a *andamanensis* (4)	303-326 av. 311.7	58.6-65.5 av. 61.8	172-195 av. 182	58.3
	(304-345 av. 325	bills never under 58, usually over 60, upto 70)		
1056 *tibetosinensis*	343, 347	69, 67	206, 198	60, 57
	(1 ♂ 1 o?)			
	(IH 325-380	from skull 69-73	201-260)	
1057 *culminatus*((11)	276-311 av. 294.6	59-61.6 av. 60.8	155-181 av. 166	56.3
	(IH 273-319	from skull 55-67	156-189)	
♀♀				
1054 *intermedius*(6)	296-319 av. 311	51.5-57.8 av. 55.6	173-210 av. 194.5	62.5
	(IH 292-343	from skull 54-65	174-224)	
1055 *levaillantii* (2)	297, 321	59, 60.5	186, —	58
	(IH 280-329	from skull 55-65	165-192)	
1055a *andamanensis* (2)	287, 310	60.5, 64.2	168, 177	58.5, 57
	(290-321	bills as in ♂♂)		
1056 *tibetosinensis*	(IH 320-341	from skull 60.67	186-240)	
1057 *culminatus*(16)	268-315 av. 290	56-62 av. 57.3	153-185 av. 168	58
	(IH 260-301	from skull 52-63	147-183)	
EL *colonorum*	300	59	172	57.3

1058 *et al.* **Corvus corone** subspp.

			Wing	Bill	Tail
1058	*orientalis*	♂♂ (3)	359, 352, 305 juv.*	57.5, 54, 49.2	212, 207, 195*
		♀ (1)	331	50	197
		(*ex* Vaurie ♂♀	345-366	from skull 59-69	200-218)
1058a	*sharpii*	♂♂ (7)	302-320 av. 312	50-53.7 av. 51	168-190 av. 180
		♀	300	48.5	175
		(♂♀	320-340	47-54	c. 200)
EL	*capellinus*	♂	337	61	199
		♀♀ (3)	302, 318, 323	55, 56, 57.3	194, 195, —
EL	*cornix*	♀	312	43.4	170

1059-61 **Corvus corax** subspp.

	Wing	Bill × height at centre of nostril	Tail
♂♂			
1059 *subcorax* (5)	398-443 av. 423	62.5-68.5 av. 65.3 × 23.5-25.2 av. 24.1	220-240 av. 226.5
	(IH 420-448	from skull 66-78	229-242)
1060 *tibetanus* (2)	447-459	70.5-75 × 24.5-26.8	253-270)
	(IH 461, 477	from skull 78-87	266, 288)
1061 *ruficollis*	382	62 × 20	206
	(IH *ex* Meinertzhagen ♂♀ 370-413	from skull 62-70	—)
♀♀			
1059 *subcorax* (7)	405-438 av. 419	61-68.5 av. 64.6 × 23-26 av. 24.4	221-227 av. 223
	(IH 399-430	from skull 69, 74	220, 223)
1060 *tibetanus*	485	73 × 27.9	266
	(IH 448-465	from skull 73-78	257-260)
1061 *ruficollis*	348-370 av. 362	57-65 av. 60.5 × 19.3-22.2 av. 20.9	186-200 av. 193
	(IH ♂♀ 370-413	from skull 62-70	—)

1062 **Bombycilla garrulus garrulus**

	Wing	Bill	Tail
3 ♀♀	115, 116 (2)	13 (2), 13.5	57, 58.5 (2)
	(112-120	10-11.5	59-67)

1063 **Hypocolius ampelinus**

	Wing	Bill	Tail
11 ♂♂ (5 by pl.)	100-105 av. 101.5	14-16.5 av. 15.5	103-116 av. 109.5
	(100-110	15-16	about 115)
6 ♀♀*	97-102 av. 99.6	14.7-16 av. 15.3	97-106 av. 100.5

* Juvenile males may be included.

(*to be continued*)

CLUTCH SIZE, INCUBATION AND HATCHING SUCCESS OF GHARIAL [*GAVIALIS GANGETICUS* (*GMELIN*)] EGGS FROM NARAYANI RIVER, NEPAL, 1976-1978[1]

H. R. Bustard[2]

Introduction

Gharial eggs were collected from 1976, in Narayani river, Nepal, for captive incubation as part of a conservation programme on the endangered gharial. In 1976 the eggs were collected by myself, in 1977 by myself in association with HMG Nepal's Special Officer (Gharial), and in 1978 by HMG Nepal gharial staff only.

The only published data for clutch size of the gharial is that of Malcolm Smith (1931) who stated,

> "Their eggs, 40 or more in number, are deposited in sandbanks"

and Parshad (1914), who removed 56 eggs from the oviducts of a 9 foot 7 inch female which he shot at Ferozpore.

The data presented below as well as providing hitherto unknown information on aspects of the nesting biology of the gharial allow comparison of clutch size, incubation and hatching success between years.

Materials and methods

Nesting took place on high riverine sandbanks which were protected by project staff, hence the date of egg laying was known precisely (Bustard, in prepn. a). In 1976 eggs were transported to Orissa for incubation. In 1977, in part because of the poor incubation results achieved in 1976, and also as part of a Nepalese training programme, all nests were incubated in Nepal. This was carried out by reburying the eggs as whole nests as collected in a mid-river sandbank at Korea Mohan which was enclosed by a predator-proof wood and wire-mesh enclosure with access through a hatch in the roof.

Due to unseasonable weather in 1977—pre-monsoon showers started at the time of egg-laying in early April and continued until the onset of the monsoon—this sandbank flooded well before hatching. Anticipating this the nests were all removed several weeks prior to hatching and completed their incubation in sand in metal trunks in a specially-heated room at Tiger Tops Jungle Lodge, Royal Chitwan National Park. As far as possible this room was maintained between 30-32°C but temperatures sometimes fell below this range. In 1978 eggs were incubated in the same island hatchery but again had to be moved due to early floods, this time to the Park headquarters at Kasara, where the hatchery room was maintained between 30-35°C with aid of heaters.

Results

The data recorded during the three years are given in Tables 1-4. The various topics

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are taken up separately below:

Clutch Size:

Clutch size in 1976 varied from 18 to 40 eggs (mean 28.6, Table 1). In 1977 the range was 16-61 (mean 36.9) eggs (Table 2) and in 1978 18-45 (mean 31) eggs (Tables 3 and 4).

The differences in mean clutch size between 1976 and 1977 should be noted (28.6 and 36.9 eggs) respectively—a mean increase/clutch of 8.3 eggs in 1977 as compared to 1976. In 1978 mean clutch size at 31 eggs was intermediate between the two previous years.

Nesting Season:

The nesting season is usually very discrete, at least in any one area. It proceeded up river towards the hill country (Bustard, in prepn. b). In 1976 all the nests collected on the Narayani river between Royal Chitwan National Park and the Indian border were laid between 29 March and 8 April (Table 1). However, one nest on the Narayani upstream of the National Park was not laid until 19 April and two nests on the small stretch of the Kali-Gandaki were laid nine days apart (12 and 21 April).

The data for 1977 show very discrete nesting by nesting area (Table 2). In 1978 nesting is again all very discrete, all occurring within six days (2-7 April) for eight nests for which date of laying is known (Table 3).

Fertility:

In many nests (see Tables 1 and 2) a sizable proportion of the eggs would appear to be infertile at least according to the criteria for fertility given above.

The mean percentage fertility in 1976 was 50.4 (data provided by Mr. L. A. K. Singh). In 1977 I recorded a mean percentage fertility of 82.5 which would appear more normal. Comparable data were apparently not recorded in 1978.

Percentage Hatch:

The percentage hatch also varied greatly (Table 1-4) from a low of 24.2% (1976) to a high of 75.1% (1977). The overall figure for 1978 was 52.5% but this is increased to 65.3% if the results of the three nests left for natural incubation are not included.

Incubation Period:

The mean for the incubation period for the three years (excluding those three nests left in nature in 1978) were 84, 94 and 83 days for the years 1976, 1977 and 1978 respectively (Tables 1-3). The considerable variations within any one year should be noted, the incubation spread being 16, 15 and 8 days in each of the three years respectively.

DISCUSSION

Inter-year variations in clutch size:

Major interest centres around the large mean differences in clutch size between years. It is known that in many species of reptiles, larger (older) females lay more eggs (Bustard 1972), although this is not necessarily the case, as some species would appear to be exceptions (Bustard, *ibid.*). However, at least in those species laying larger egg clutches inter-year differences in clutch size or total egg production, may be more important than any effect of larger clutches from larger females, as shown by Bustard (*ibid.*) on the basis of very extensive data for the green sea turtle (*C. mydas*), a species in which clutch size is positively correlated with female size.

Bustard postulated that these inter-year differences in egg production by *C. mydas*, may reflect differing feeding opportunities in the inter-nesting years spent at sea. In the case of the gharial, data were recorded on a small number of breeding females which presumably bred annually. The 1976 data (on nine nests) shows a mean clutch size of 25.5 eggs whereas the 1977 data (on 16 nests) shows a mean clutch size of 36.9 eggs—a mean increase/clutch of 11.4 eggs. No obvious explanation is available to explain these differences. In 1978 the data on 10 nests gave an intermediate figure of 31.0 eggs. These differences cannot be explained on the basis of sampling biases as an attempt was made to collect every nest each year.

An examination of the distribution of clutch size variations in the various years indicates that in all three years there were no clutches of under 10 eggs (the smallest clutches in the three years were 16, 16 and 18 eggs respectively). The largest clutch sizes were 39, 61 and 45 eggs respectively. However, the mean of 36.9 eggs in 1977 reflects a marked shift towards larger clutch sizes in *all* nests. Twelve (of 16) nests fell in the 31-40 clutch size group in 1977 and three occurred in larger groups as opposed to three (of 9) in this group in 1976 which represented the largest clutch size grouping in 1976.

Discrete nesting season:

The discrete nesting season of this population of the gharial has been commented upon elsewhere for the 1977 nesting season (Bustard, in prepn. b). The data presented here indicates that a very discrete nesting season characterised all three years.

Fertility:

A percentage of apparently infertile eggs are a feature of most reptiles which deposit large clutches of eggs. However, the percentage fertility figure for 1976 (of 50.4%) should be treated with caution as it appears abnormally low. It seems likely that some early embryonic deaths may have remained undetected at subsequent examination. The 82.5% figure for 1977 is considered more normal. Examination of the intra-nest data (Table 2) indicates that fertility varies from a high of 100% (two nests) to a low of 22.8% but with the exception of this single nest and one of 59% the lowest per cent fertility recorded was 73%.

Percentage Hatch:

The percentage hatch figures are clearly closely related to the level of fertility. Examination of the detailed data for 1977 shows that most fertile eggs result in hatchlings. The differences between fertility and percentage hatch figures are accounted for by embryonic deaths—which except for exceptional circumstances such as flooding—are usually relatively few.

Hatching results were extremely poor in 1976. Reasons for this are not known. The distance over which the eggs were transported, 1400 km. was not a key factor, gharial eggs often being transported over very long distances in the Project either freshly laid or two-thirds incubated and subsequently achieve very high levels of successful hatch (Bustard in prepn. a.; and S. Choudhury, unpubl.). The 1977 hatching figures (75%), on the other hand are surprisingly good, as nest temperatures were extremely low (near 28.3C) due to the persistant wet weather throughout the incubation period (Bustard, in prepn. b). Furthermore, these eggs were dug up twice during incubation, once when freshly laid, and again towards the end of the incubation period, to complete their incubation in a heated room where, in the absence of electricity, temperatures were frequently less than ideal. The 1978 hatch (65%) was likewise achieved by HMG Nepal staff despite having to move the eggs twice at similar times to 1977.

Natural nest failures:

The reason for the very poor incubation success of at least two of three nest left in

Table 1

Date of egg laying, nesting site, clutch size, hatching success and incubation period (days) in 1976.

Nest No.	Date of Laying	Location	Clutch Size	Number Fertile	Percentage Fertile	Number Hatched	Percentage Hatched	Iucubation Period
1.	29/3	Narayani River	27	19	70.4	4	14.8	85
2+3*	3/4	Narayani River	41	33	80.5	13	31.7	85-6
4.	5/4	Narayani River	18	17	94.4	3	16.7	83
5.	8/4	Narayani River	39	20	51.3	17	43.6	76
6.	8/4	Kali-Gandaki	32	29	90.6	23	71.9	92
7.	12/4	Kali-Gandaki	24	0	0	0	0	—
8.	19/4	Narayani River	33	22	66.7	5	15.2	84-5
9.	21/4	Kali-Gandaki	16	0	0	0	0	—
Mean	—	—	25.5	—	50.4	—	24.2	84

* These nests were collected by local people and the eggs mixed prior to their reaching project staff.

Table 2

Date of egg laying, nesting site, clutch size, hatching success and incubation period (days) in 1977.

Nest No.	Date of Laying	Clutch Size	Number Fertile	Percentage Fertile	Number Hatched	Percentage Hatched	Incubation Period
1.	4/4	39	23	59.0	22	56.4	95
2.	4/4	16	12	75.0	8	50.0	94-6
3.	1/4	47*	36	78.2	25	54.3	98-102
4.	6/4	38*	27	73.0	25	67.5	93-95
5	2/4	33*	32	100.0	32	100.0	99
6	1/4	32	32	100.0	28	90.6	95
7.	3/4	61	53	90.6	50	82.9	95-7
8.	31/3	31	29	93.5	29	93.5	99-101
9.	31/3	50***	36	76.6	36	76.6	101-2
10.	3/4	34	32	94.1	28	82.3	96
11.	8/4	37*	33	91.7	33	89.1	91-2
12.	14/4	35	8	22.8	8	22.8	89
13.	14/4	37*	33	91.7	33	91.6	88-89
14.	8/4	31	27	87.1	22	70.9	90-91
15.	9/4	37**	35	100.0	34	97.1	87-8
16.	10/4	33*	28	87.5	25	75.7	89-90
Mean	—	36.9	—	82.5	+	75.1	94

Note: Due to damage at the time of laying the number incubated may vary slightly from the number laid. Clutches marked (*) indicate that 1 egg less, (**) 2 eggs less and (***) 3 eggs less that the clutch size was incubated.

TABLE 3

DATE OF EGG LEYING, NESTING SITE, CLUTCH SIZE, HATCHING SUCCESS AND INCUBATION PERIOD (DAYS) IN 1978. ALL PLACES NAMED REFER TO NARAYANI RIVER.

Nest No	Date of Laying	Location	Clutch Size	Number Hatched	Percentage Hatched	Incubation Period
1.	3/4	Tamaspur	45	40	88.8	84
2.	3/4	Badarjhola	44	18	40.9	85-7
3.	4/4	Badarjhola	42	40	95.2	83-4
4.	5/4	Tamaspur	25	17	73.9	83
5.	6/4	Tamaspur	18	2	11.1	89
6.	6/4	Tamaspur	29	25	86.2	81
7.	7/4	Tamaspur	24	5	20.8	83
Mean	—	—	32.4	—	65.3	83

TABLE 4

DATE OF EGG LAYING, NESTING SITE, CLUTCH SIZE, HATCHING SUCCESS AND INCUBATION PERIOD (DAYS) FOR THREE NESTS LEFT FOR NATURAL INCUBATION IN 1978

Nest No	Date of Laying	Location	Clutch Size	Number Hatched	Percentage Hatched	Incubation Period
1.	Not recorded	Badarjhola	23	10	56.5	Not known
2.	Not recorded	Badarjhola	27*	0	0	Not known
3.	2-4-1978	Deoghat	33	2	6.0	105
Mean	—	—	27.7	—	31.8	—

* Eggs markedly smaller than normal.

nature in 1978 is not known.

The clutch of markedly smaller eggs may well have been defective. The HMG Nepal report (Maskey and Ram Pritt 1978) does not provide information on this point. It would seem, however, that early onset of the monsoon resulted in water logging of the nests, resulting in total loss of two nests and loss of most of the eggs in the third nest the only eggs hatching being the uppermost which were not flooded. A similar situation has been observed in the Saltwater Crocodile (*Crocodylus porosus*) by Webb *et al.* (1977) and by Kar and Bustard (in prepn.). In the absence of concrete data this is purely hypothesis, however, Bustard (in prepn. b), on the basis of his data, stated that in 1977 most natural nests in Narayani would have failed to hatch because of water logging following early onset of the monsoon. It appears that this was again the situation in 1978.

Incubation period:

The means for 1976 and 1978 vary by only one day (83 and 84 days respectively). The ten-eleven day longer incubation period in 1977 is explicable on the basis of the very low temperatures existing in the natural sandbanks in that year, commented on by Bustard (in prepn., b), as a result of pre-monsoon showers commencing in early April at the time of egg laying, and persisting until the onset of the monsoon proper in June. Since egg incubation is temperature-related, the persistant rains, which cool down the nesting sandbanks, result in a lengthened incubation period.

ACKNOWLEDGEMENTS

I am indebted to; HMG Nepal National Parks and Wildlife Conservation Office, in particular the respective Chiefs, Mr. P. B. S. Pradhan and Mr. B. B. Shah, for authorities to carry out this work; Mr. H. Mishra, Government Biologist; Mr. Ram Pritt Yadav, Special Officer (Gharial) who worked with me in 1977; Tiger Tops Pvt. Limited in particular Mr. Jim Edwards, Mr. John Edwards and Dr. C. McDougal for many kindnesses, assistances and provision of an incubation room in 1977; Mr. L. A. K. Singh for information on hatching success of 1976 eggs; Mr. Ashish Chandola for assistance in the operation of the heated hatchery at Tiger Tops in 1977; and Mr. P. C. Pani, Range Officer, Gharial Project, Orissa, who accompanied me to Nepal during both the 1976 and 1977 egg collections and greatly facilitated the logistical side of the operation.

REFERENCES

BUSTARD, H. R. (1972): Sea Turtles: Conservation and Natural History. Collins, London and Sydney.

———— (in prepn., a): Conservation of the Gharial *Gavialis gangeticus* (Gmelin) (Reptilia; Crocodilia) in Nepal.

————(In prepn., b): Nesting Ecology of the Gharial *Gavialis gangeticus* (Gmelin) in Narayani River, Nepal.

CHOUDHARY, S. (1980): Ecological Studies on the Gharial *Gavialis gangeticus* (Gmelin). Ph.D. thesis. University of Lucknow.

KAR, S. & BUSTARD, H. R. (in prepn.): Nesting ecology of the Saltwater Crocodile (*Crocodylus porosus* Schneider).

MASKEY, T. M. & YADAV, R. P. (1978): Report on Gharial Breeding. Unpubl. Rep. to HMG Nepal, National Parks and Wild Life Conservation Office.

SMITH, MALCOLM (1931): The Fauna of British India. Reptilia and Amphibia. *1* Loricata, Testudines. Taylor & Francis, London.

WEBB, G. J. MESSEL, H. AND MAGNUSSON, W. (1977): The nesting of *Crocodylus porosus* in ARNHEM LAND, NORTHERN TERRITORY, AUSTRALIA. *Copeia* 1977 (2): 238-249.

PARSHAD, B. (1914): The Gharial (*Gavialis gangeticus*). *J. Bombay nat. Hist. Soc. 23*: 369-370.

NEW DESCRIPTIONS

PSEUDOSCORPIONS FROM SOUTH INDIA—FOUR NEW SPECIES OF THE FAMILY CHERNETIDAE MANGE AND CHELIFERIDAE HAGEN (PSEUDOSCORPIONIDA, MONOSPHYRONIDA)[1]

S. SIVARAMAN[2]

(*With four text-figures*)

Lamprochernes indicus sp. nov. of the family Chernetidae Mange and *Withius suis* sp. nov., *Metawithius* (*Microwithius*) *chamundiensis* and *M.* (*M.*) *bulli* sp. nov. are described from South India and compared with related species. A Key to the new species is also given.

INTRODUCTION

The members of the super family Cheliferoidea, Chamberlin are widely distributed in Continental India. A number of species were described from India and Ceylon by Beier (1973, 1974) and Murthy and Ananthakrishnan (1977). In the present paper, new species of the genera *Lamprochernes* Tomosvary, *Withius* Kew and *Metawithius* Chamberlin are described. *Lamprochernes indicus* sp. nov. and *Withius suis* sp. nov. were collected from soil litter by using modified Berlese funnel (Sivaraman 1979) and *Metawithius* species were collected from bark of trees. The type material is deposited in the Museum of the Department of Zoology, Loyola College, Madras.

KEY TO THE NEW SPECIES OF FAMILIES CHERNETIDAE AND CHELIFERIDAE:

1. Accessory teeth absent: both palpal fingers with equally developed venom tooth and venedens; flagellum with 4-5 setae; Sternites of male mostly with special Setigerous area; (Family Cheliferidae Hagen and subfamily Withinae Chamberlin) 2

   Accessory teeth present atleast in smaller numbers; only the movable finger of the palp with venom tooth and venedens; very rarely with rudimentary venedens on the fixed finger, if so, the accessory teeth very clear. (Family Chernetidae, Mange)...*Lamprochernes indicus* sp. nov.

2. Carapace with sides subparallel, as wide at the region of the anterior furrow as at the posterior border; males with patches of microsetae on Sternites V to IX or X (both inclusive) with true eyes. .... *Withius suis* sp. nov.

   Carapace broader at the anterior furrow region or slightly anterior there to; sides converging abruptly infront and gradually to the rear; males with patches of microsetae on Sternites VII to IX (both inclusive) only with eye-spots. (Genus *Metawithius* Chamberlin and subgenus *Microwithius* Redikozev). 3

3. Serrula exterior with 17 blades; palpal and pedal podomeres slender. ....*Metawithius* (*Microwithius*) *chamundiensis* sp. nov.

   Serrula exterior with 15 blades; palpal and pedal podomeres stouter. ....
   ......*Metawithius* (*Microwithius*) *bulli* sp. nov.

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Lamprochernes indicus sp. nov. (Fig. 1)

Carapace and palps dark yellowish brown and the remaining parts light yellowish brown; carapace smooth, with rounded granules on the lateral margins; with anterior prominent groove, nearly median and posterior groove obscure and nearly median between anterior groove and posterior margin of carapace; eyes or eye-spots absent; anterior end with 8, posterior margin with 10 setae; carapace distinctly longer than broad, 1.25 times as long as wide.

Tergites fairly sclerotised; all tergites and sternites except I, II and III divided more or less clearly by a nearly linear suture; tergites I and II markedly narrowed; tergal chaetotaxy of an imperfect biseriate type, with about 6 discal and 16 marginal setae, posteriorly with 6 discal and 20 marginal setae; sternal chaetotaxy similar, with 6 discal and 18 to 20 marginal setae; tergites with prominent lateral maculae or spots occupying nearly the full outer half of each scute; but less prominent on sternites; X tergite with 2 and XI tergite with 6 pseudotactile setae and X and XI sternites with two pseudotactile setae each; pleural membrane reticulostriate. Vestitural setae long, slender and acuminate.

Palm of the chelicera with reticulate markings, with 5 setae *sb* and *b* short; flagellum with 3 blades; fixed finger with 3 terminal serrations followed by 3 triangular teeth; apical tooth of the movable finger well developed, subapical tooth blunt; lamina interior with 4

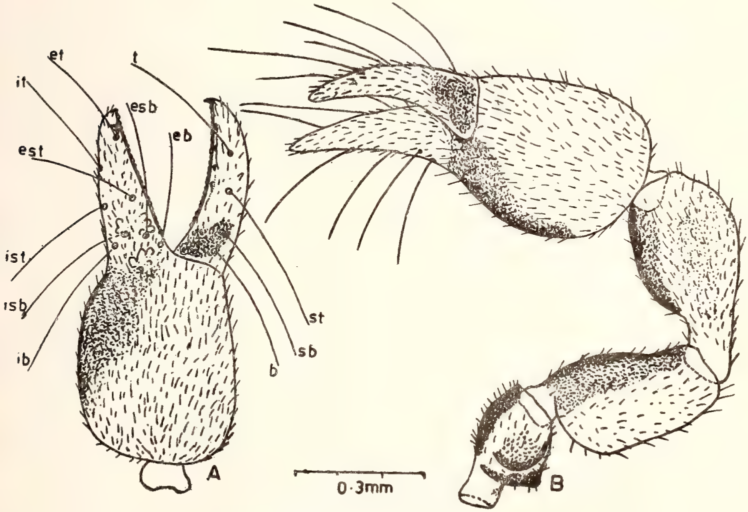

Fig. 1. *Lamprochernes indicus* sp. nov. A—Chela lateral view; B—Palp entire (♀).

dentate sub-apical lobes; serrula exterior with 17 ligulate blades; galea of the male stout and short and of female, prominent with 3 terminal and 2 subterminal curved branches; galea seta long and acuminate; shorter than galea and equal to the length of galea in the male. Chelicerae, 2.5 times as long as deep, 1.5 times as long as the movable finger.

Palps longer than the body, segments fairly robust; finely granulated on the flexor margins of femur, tibia and near the base of chelal fingers. Trochanter coarsely granulated, with a prominent cone-like protruberance; 1.75 to 1.8 times as long as wide; femur robust, gently concave anteriorly and strongly convex posteriorly; pedicellate; slightly shorter than tibia 1.34 time as long as trochanter and 1.75 to 1.85 times as long as wide; tibia slightly but distinctly shorter than carapace; with a curved pedicel, 1.85 to 1.95 times as long as wide; chela robust; pedicellate, 2.45 to 2.55 times (with pedicel), 2.28 to 2.35 times (without pedicel) as long as wide; hand more or less conical in dorsal view, slightly longer than tibia; 1.41 to 1.45 times (with pedicel), 1.22 to 1.28 times (without pedicel) as long as wide; fingers gently curved and only slightly longer than the breadth of hand and shorter than the length of hand; chela, 1.84 times as long as tibia; fixed finger with 29 and movable finger with 32 marginal teeth; movable finger with four accessory teeth opposite to the 10th to 21st marginal teeth at regular intervals; the exterior accessory teeth absent; fixed finger with two subapical accessory teeth interiorly nearer to the 4th and 5th marginal teeth; *sb* and *b* separated by three areolar diameters; *st* in between *t* and *sb;* nodus ramosus opposite to 18th marginal tooth and cauded to *t;* *et* nearly terminal, opposite to 7th marginal teeth; *it* distad of median and much distal of *est; est* and *ist* about opposite to each other; the distance between the finger *tip* and *it* more than the distance between *isb* and *ist; isb, ib, esb* and *eb* proximal of basal marginal teeth; a submedian pseudotactile seta occurring on each finger; two dense sensory—spots interiorly between *ist* and *isb;* four such spots proximed of *isb* and *esb;* three more sensory spots distal of *esb* exteriorly; movable finger devoid of such spots.

Legs stout, smooth with vestitural setae; basifemur shorter than telofemur and movably articulated.

Leg. I: femur (both segments), 2.89 times; tibia, 3.82 times and tarsus, 3.8 times as long as deep. Vestitural setae of tibia and tarsus long and acuminate. Leg IV: femur (both segments), 3.5 times; tibia, 3.88 times; tarsus, 4.18 times as long as deep. Leg III with one pseudotactile seta at the middle region of the tarsus and Leg IV with pseudotactile setae one at the distal half of tibia and another at the 1/3rd of the proximal half of tarsus.

Male genitalia of characteristic lamprochernetine type, female genitalia simple with tuft of 18 setae in the anteriomedial region and posteriorly guarded with a row of 10 setae. *Holotype*: female (Measurements in mm.):

Total body length, 2.380; abdominal breadth, 0.780; carapace, 0.612 by 0.489; chelicera, 0.334 by 0.133; movable finger, 0.289 long.

Palps: trochanter, 0.311 by 0.178; femur, 0.417 by 0.234; tibia, 0.478 by 0.256; chela, 0.878 (without pedicel, 0.812) by 0.356; hand, 0.500 (without pedicel, 0.434) by 0.356; fingers, 0.378 long.

Leg I: miofemur, 0.289 by 0.100; tibia, 0.234 by 0.061; tarsus, 0.211 by 0.056. Leg IV: miofemur, 0.467 by 0.133; tibia, 0.345 by 0.089; tarsus, 0.256 by 0.061.

Collected from soil litter, Bangalore, Karnataka, 10-7-1977.

Allotype: male (Measurements in mm):

Total body length, 2.18; maximum width, 0.712. Collected from soil litter, Bangalore, Karnataka, 10.7.1977.

Paratype: 2 females and one male collected from the same locality, 10-7-1977.

This new species is very closely related to *L. oblongus* (Say) in having *st* of the movable palpal finger in the middle in between *sb* and *t* and the palpal fingers shorter than that of hand without pedicel. It could be separated from the same by the stouter nature of palpal femur and slender nature of chela (*L. indicus*—femur, 1.75 to 1.85 times and chela with pedicel, 2.45 to 2.55 times as long as wide; *L. oblongus*—femur, 2.0 times and chela, 2.3 times as long as wide) and the elongated nature of the body. *L. indicus* sp. nov. can be separated from *L. savignyi* (Simon), recorded from India by Beier, by the position of *st* in between *t* and *sb* and stouter nature of palpal femur and tibia.

Withius suis sp. nov. (Fig. 2)

Carapace well sclerotised, anterior 1/3 region reddish and posterior 2/3 region brownish in males; moderately sclerotised in females; carapacal furrows distinct; anterior furrow slightly anterior to the first pair of legs and the posterior in a level with second pair of legs; anterior region deeply convex and the posterior region much flattened; sides subparallel with the maximum width in the posterior region; postero-lateral regions membranous; anterior pair of eyes well developed; surface of the carapace with a large number of well distributed plumose setae; anterior end with 6 and posterior end with 12 such setae; carapace, 1.31 times as long as wide.

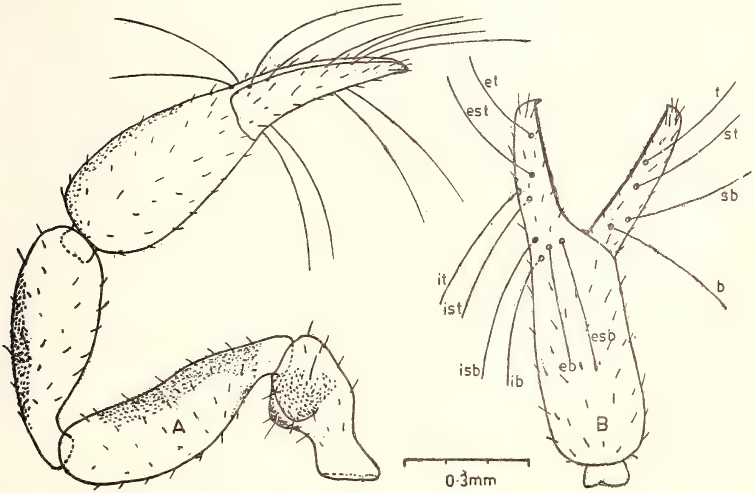

Fig. 2. *Withius suis* sp. nov. A—Pedipalp entire (♂); B—Chela lateral view.

Tergites brownish; well sclerotised; tergites completely divided excepting XII; tergites I to III uniseriate and the rest biseriate; tergal chaetotaxy of male; 12—12—12—6/10—6/10 —6/12 — 6/10 — 6/12 — 6/10 —6/8 — 8— 2m., female with lesser number of setae with the chaetotaxy: 8—10—12—2/10—2/8—4/10 —4/10—4/10—10—2m. Sternites less sclerotised than the tergites; sternites IV to X completely divided; sternal chaetotaxy of female from the IV sternite: 2/12—2/10—4/12—4/ 12—4/10—4/10—4/8—10—2m. (The numbers in the upper row indicate the discal series and those in the lower row indicate the marginal series). Sternal chaetotaxy of male characteristic; sternite IV to IX with bristle patches in the median region of the scute, each patch with 25 to 30 setae; more setae are seen in the posterior sternites. Sternite X with 14 setae, XI with 8 setae and XII with 2 setae; X and XI tergites and sternites with four pseudotactile setae each.

Palm of the chelicera nongranulated but with net like markings; with 5 setae; *ls*, *es* and *is* long; *sb* and *b* short and acuminate; fixed finger with 3 terminal serrations followed by 4 triangular teeth; lamina interior well developed with an elongated apical dentate process; apical tooth of the movable finger curved and blunt and subapical tooth flattened and blunt; galea of male short, stout with three terminal vestigeal bud-like projections, galea of female stout with two terminal and one subterminal branches; galeal seta equal to the length of galea; serrula exterior with 14 blades; flagellum with 4 blades, distal one serrated; chelicerae, 1.73 times as long as deep and 1.36 times as long as movable finger.

Palps reddish brown, dorsal tubercle of trochanter, flexor and extensor margins of femur and tibia well and coarsely granulated; most of the vestitural setae of the trochanter, femur and tibia plumose; trochanter with a short pedicel and dorsal tubercle; 1.83 times as long as wide; femur with a short pedicel; extensor margin strongly convex and the flexor margin more or less straight; 3.24 times as long as wide; tibia with a long pedicel, which 1½ times as long as wide; clavate; 2.79 times as long as wide; chela slender with a short pedicel, 3.78 times (with pedicel), 3.0 times (without pedicel) as long as wide; hand shorter than femur and tibia and much longer than fingers; 2.17 times (with pedicel), 1.83 times (without pedicel) as long as wide, fingers, 0.74 times as long as the hand (with pedicel) and 0.43 times as long as the chela (with pedicel); fingers equal in length; *ist* of the fixed finger proximal in position, *est* closer to *et* than to *esb;* almost in the middle region of the finger; *ib* and *eb* in a same level; *it* below the level of *est* and proximal in position. Venom glands and venom ducts well developed in both the fingers; movable finger with 32 teeth of which the proximal teeth are flattened and fixed finger with 30 retroconical teeth.

Legs yellowish in female and brownish in male; weakly granulated; vestitural setae mostly acuminate and in some regions clavate. Leg I: basifemur shorter than telofemur; basifemur, 0.83 times; telofemur, 2.0 times; tibia, 4.0 times and tarsus, 5.0 times as long as deep. Leg IV: miofemur robust and stout; longer than tibia; tibia more swollen along the flexor margin; miofemur, 3.03 times; tibia, 5.0 times and tarsus, 5.8 times as long as deep; without pseudotactile setae; however 2 elongated setae are seen near the tip of the tarsus, claws normal, arolium simple and undivided; shorter than claws.

Male genitalia complicated with 6 setae on either side of the operculum; female genitalia with one median and two lateral cribriform plates; coxal area sexually differentiated; IV coxa of female broader with a cluster of acuminate bristles (12) in the posterior area; coxal area of male simple.

Holotype: male (Measurements in mm):

Total body length, 2.246; maximum width, 0.834; carapace, 0.70 by 0.534; chelicerae, 0.211 by 0.122; fingers, 0.156 long.

Palps: trochanter, 0.367 by 0.20; femur, 0.612 by 0.187; tibia, 0.589 by 0.211; chela 0.967 (without pedicel, 0.767) by 0.256; hand, 0.556 (without pedicel, 0.467) by 0.256; fingers, 0.411 long.

Leg I: basifemur, 0.111 by 0.133; telofemur, 0.267 by 0.133; tibia, 0.289 by 0.072; tarsus, 0.278 by 0.056. Leg IV: miofemur, 0.523 by 0.172; tibia, 0.445 by 0.089; tarsus, 0.322 by 0.056.

Collected from debris of piggery, Madras, 31-3-1976.

Allotype: female (Measurements in mm):

Total body length, 2.091; maximum width, 0.712.

Collected from debris of piggery, Madras, 31-3-1976.

This species is very closely related to *Withius indicus* Murthy & Ananthakrishnan in having similar number of setae on tergites and sternites. It can be differentiated by the slender nature of palpal podomeres; the setigerous area of the sternites of males having lesser number of sensory spines and much slender nature of IV pair of walking leg.

It can be separated from *W. subruber* (Simon) (closely related to *W. indicus*), by the galea being sexually differentiated and the longer nature of the body.

Metawithius (Microwithius) chamundiensis sp. nov. (Fig. 3)

Carapace brownish, densely and coarsely granulated; very distinctly constricted from the middle region towards the distal. Anterior transverse furrow well developed and deep, granulated within; posterior furrow distinct but shallow. Anterior furrow strongly arched forwards at the sides. Eye spots two, large and distinct and non corneate. Vestitural setae mostly plumose. Anterior end of the carapace straight with 6 small clavate setae; cucullus well developed; posterior end with 10 plumose setae. Carapace, 1.34 times as long as wide.

Tergites transversely well granulated, and undivided; tergal setae short and strongly plumose. Chaetotaxy of male 10—10—10—8(4)—10(4)/2 — 10(4)/2 — 10(4)/2 — 10(4)/2—8(4)/2—6(2)/2—10—0. Tergite XI with 2 elongated tactile setae. Sternites ill sclerotised, sternal setae simple and acute. Sternal chaetotaxy of male from the IV sternite shows characteristic difference 10 — 10 — 12 — 10/(24) — 10(2)/(25) — 10(2)/(26) — 10(2)—10—2m. The sternites VII to IX of the male with, roundish areas near the median line, each with 24—26 closely approximated, rather long and conical sensory spines. Sternite XI with 4 slightly elongated pseudotactile setae; in female the setal patches on the sternites absent.

Palm of the chelicera very finely granulated and rasplike. All the 5 setae well developed; *ls* and *is* long and acuminate. *es*, *sb* and *b* of equal and of moderate length and acuminate. Flagellum with 4 blades, the second branch from the distal is the longest, acuminate and not serrated. Fixed finger with 3 terminal serrations followed by 3 triangular teeth. Lamina interior well developed with 6 serrations followed by 2 rounded dentate lobes. Basally the lamina is very broad, more or less closing the gap between the two fingers. Movable finger with apical tooth well

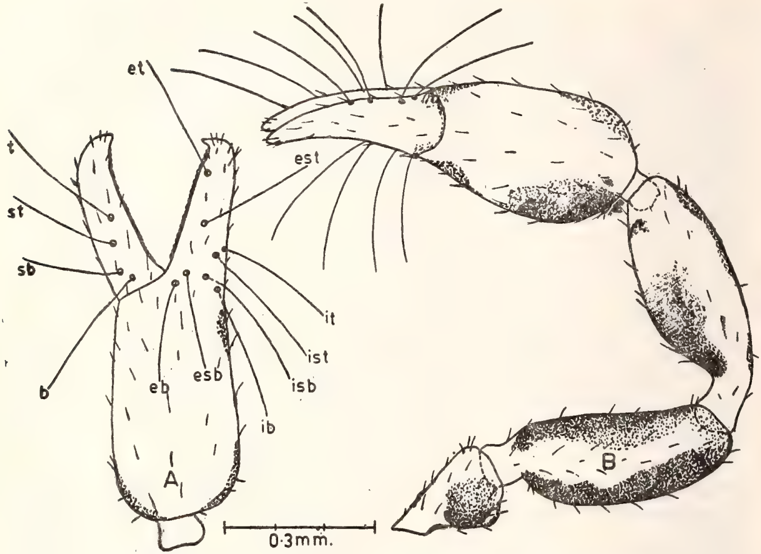

Fig. 3. *Metawithius* (*Microwithius*) *chamundiensis* sp. nov. A—Chela lateral view; B—Pedipalp entire (♂).

developed and subapical tooth is lobe like. Serrula exterior with 17 blades; in male galea seta equal to the length of the galea; stout and terminally blunt; in female galea slender and terminally branched with 3 rami. Chelicera, 2.11 times, as long as deep.

Palps yellowish brown, coarsely well granulated excepting the pedicels and chela. Palpal segments slender; vestitural setae of the podomeres excepting the chela clavate.

Trochanter with a long pedicel, dorsal tubercle well developed; 1.4 times as long as wide. Femur with a short pedicel, more or less swollen along the extensor margin, with the maximum width in the basal region, 2.77 times as long as wide; tibia with a long pedicel, 1.3 times as long as wide; medially swollen in the flexor margin and distally swollen in the extensor margin, 2.75 times as long as wide; chela smooth, rounded, posteriorly swollen on the flexor margin, 3.55 times (with pedicel), 3.32 times (without pedicel) as long as wide. Hand, 2.1 times (with pedicel), 1.86 times (without pedicel) as long as wide; hand with pedicel more or less equal to the length of tibia and slightly longer than that of femur; hand distinctly longer than fingers. Fingers subequal in size, 0.40 times as long as the chela and 0.70 times as long as the hand. Venom teeth and glands equally developed in both the fingers. Movable finger with 30 and fixed finger with 29 retroconical teeth. Proximal 1/5 of both the fingers devoid of teeth. The tactile setae *sb* and *b* of the movable finger basal in position and separated by two areolar diameters *st* midway between *sb* and *t; t* in the distal half of the finger; *it* proximal in position in a level with *ist; est* in the distal region of the finger.

Legs robust, golden yellowish in colour, finely granulated; vestitural setae clavate and acuminate. Leg I: basifemur shorter than telofemur, 0.90 times as long as deep; telofemur, 1.9 times; tibia, 3.07 times; tarsus, 4.44 times as long as deep. Leg IV: miofemur, 2.71 times; tibia ,4.42 times; tarsus, 4.6 times as long as deep. Tarsus with a pseudotactile seta situated slightly distal of the middle region; 0.52 times as long as the tarsus. Claws normal, arolium entire and equal in length to that of claws.

Male genitalia well developed, genital sacs well elongated. Anterior operculum with 2 setae on either side.

Holotype: male (Measurements in mm.):

Total body length, 1.946; maximum width, 0.767: carapace, 0.611 by 0.455; chelicera, 0.211 by 0.100.

Palps: trochanter, 0.20 by 0.145; femur, 0.478 by 0.172; tibia, 0.489 by 0.178; chela, 0.867 (with pedicel), 0.812 (without pedicel) by 0.245; hand, 0.512 (with pedicel), 0.456 (without pedicel) by 0.245; fingers, 0.355 long.

Leg I: basifemur, 0.111 by 0.122; telofemur, 0.233 by 0.122; tibia, 0.233 by 0.122; tarsus, 0.222 by 0.056.

Leg IV: miofemur, 0.422 by 0.155; tibia, 0.344 by 0077; tarsus, 0.255 by 0.055.

Collected from barks, Chamundi Hills, Mysore, Karnataka State, 25-5-1977.

This species is related to *Metawithius* (*M.*) *indicus* Murthy & Ananthakrishnan in having the patches of setae on the sternites VII to IX. It can be easily separated from *M.* (*M.*) *indicus* by the slender nature of the chela and the slender nature of the podomeres of the IV pair of walking legs and by the undivided nature of the tergites and simple unbranched nature of the galea of the male.

Metawithius (Microwithius) bulli sp. nov. (Fig. 4)

Carapace with two distinct anterior furrows; wider at the region of the anterior furrow; brownish, densely and coarsely granulated; very distinctly contsricted from the middle region towards the distal. Anterior furrow well developed and strongly arched forwards at the sides; posterior furrow distinct but shallow. Eye spots two, large and non corneate. Vestitural setae mostly plumose. Anterior end of the carapace straight with 6 small clavate setae; cucullus well developed; posterior end with 12 plumose setae. Carapace, 1.1 to 1.2 times as long as wide.

Tergites transversely well granulated and undivided; tergal setae short and strongly plumose. Chaetotaxy of male 10—12—10—12(2) — 10(4)/2 — 10(4)/2 — 10(4)/2 — 8(4)/2 — 8(4)/2 — 8(4)/2 — 12 — 2 m. Tergite XI with 2 elongated tactile setae. Sternites ill-sclerotised, sternal setae simple and acute; sternal chaetotaxy of male from IV sternite shows characteristic difference 10—10 —12 — 15/(25) — 14(2)/(25)—10(2)/(25) —10(2) — 12 — 2m. Sternites VII to IX of the male with roundish areas near the median line, each with 25 closely approximated, long and sensory spines. Sternite XI with 4 slightly elongated pseudotactile setae; in female the setal patches on the sternites are absent.

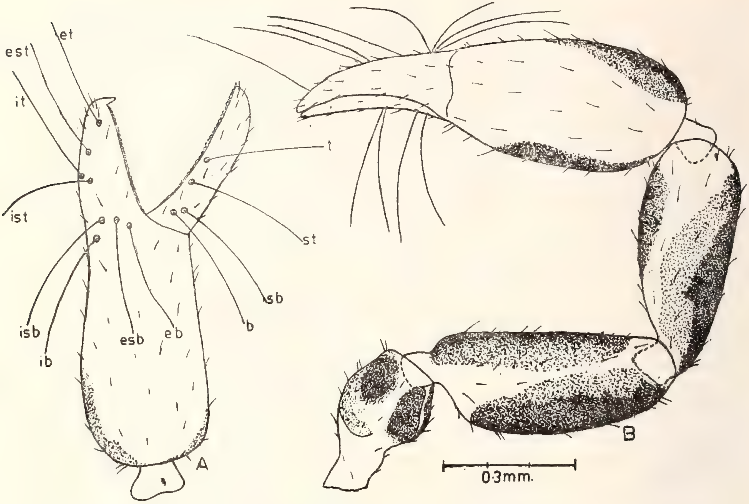

Fig. 4. *Metawithius* (*Microwithius*) *bulli* sp. nov. A—Chela lateral view; B—Pedipalp entire (♂).

Palm of the chelicera very finely granulated and rasplike. All the five setae well developed; except *b* all the other four setae (*ls, is, es* and *sb*) are long and acuminate. Flagellum with 4 blades and not serrated. Fixed finger with 3 terminal serrations followed by 3 triangular teeth. Lamina interior well developed with 6 serrations followed by 2 rounded lobes. Movable finger with the apical tooth well developed and subapical tooth lobe like; serrula exterior with 15 blades. In male galeal seta short, stout and blunt terminally; in female galea slender and terminally branched with 3 rami; chelicera, 1.9 times as long as deep.

Palps yellowish brown, densely granulated excepting the pedicels and chela. Palpal segments stout; vestitural setae of the podomeres excepting the chela clavate. Trochanter with a long pedicel, dorsal and lateral tubercles well developed; 1.67 to 1.72 times as long as wide. Femur with a short pedicel, more swollen along the extensor margin with the maximum width in the basal region, 2.56 to 2.7 times as long as wide; tibia with a long pedicel; medially swollen in the flexor margin and distally swollen in the extensor margin, 2.3 to 2.6 times as long as wide; chela smooth, posteriorly swollen on the flexor margin, 2.9 to 3.3 times (with pedicel), 2.7 to 3.1 times (without pedicel) as long as wide. Hand, 1.8 to 2.0 times (with pedicel) 1.5 to 1.7 times (without pedicel) as long as wide; hand with pedicel more or less equal to the length of tibia and femur; hand distinctly longer than fingers. Fingers subequal in size, 0.42 times as long as the chela and 0.63 times as long as the hand. Venom teeth and glands equally developed in both fingers. Movable finger with 33 and fixed finger with 27 retroconical teeth. Proximal 1/5 of both the fingers devoid of teeth. The tactile setae *sb* and *b* of the movable finger basal in position and separated by one areolar diameter; *st* midway between *sb* and *t; t* in the exact middle region of the finger; *it* in the middle of the finger more or less in a level with *ist; est* in the distal region of the finger.

Legs robust, golden yellowish in colour, finely granulated; vestitural setae clavate and acuminate. Leg I: basifemur shorter than telofemur, 0.83 times as long as deep; telofemur, 2.08 times; tibia, 3.28 times; tarsus, 4.0 times as long as deep. Leg IV: miofemur, 2.56 times; tibia, 3.77 times, tarsus, 4.16 times as long as deep. Tarsus with a pseudotactile seta situated in the middle region; 0.6 times as long as the tarsus. Claws normal, arolium entire and slightly shorter than the claws.

Male genitalia well developed, genital sacs well elongated. Anterior operculum with 3 setae on either side.

Holotype: male (Measurements in mm.):

Total body length, 2.035; maximum width, 0.778; carapace, 0.656 by 0.578; chelicera, 0.211 by 0.111.

Palps: trochanter, 0.289 by 0.177; femur, 0.556 by 0.219; tibia ,0.567 by 0.211; chela, 0.867 (with pedicel), 0.812 (without pedicel) by 0.30; hand, 0.578 (with pedicel), 0.523 (without pedicel) by 0.30; fingers, 0.367 long.

Leg I: basifemur, 0.111 by 0.133; telofemur, 0.278 by 0.133; tibia, 0.256 by 0.078; tarsus, 0.222 by 0.056. Leg IV: miofemur, 0.456 by 0.178; tibia, 0.378 by 0.10; tarsus. 0.278 by 0.067.

Collected from barks, Bangalore, Karnataka State, 25-5-1977.

Allotype: female (Measurements in mm.):

Total body length, 2.072; maximum width, 0.789.

Collected from bark, Bangalore, Karnataka State, 25-5-1977.

Paratype: 5 males and 1 tritonymph collected at the same locality, 25.5.1977.

This species is closely related to *Metawithius* (*M.*) *chamundiensis* in having patches of setae on sternites VII to IX and by the undivided nature of the tergites. It can be distinguished from *M.* (*M.*) *chamundiensis* by the stouter nature of the palpal and pedal podomeres and lesser number of blades in serrula exterior, 15 blades against 17 or 18 in *M.* (*M.*) *chamundiensis* sp. nov. and *M.* (*M.*) *indicus* Murthy & Ananthakrishnan respectively.

ACKNOWLEDGEMENTS

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REFERENCES

BEIER, M. (1932): Pseudoscorpionidea, II Sub ord. Cheliferinea, *Das Tierreich, 58*: 1-294.

———— (1951): Die pseudoscorpione Indochinas. *Mem. Mus. Nat. Ser.* A. 1, *2*: 47-123.

———— (1963): Die Pseudoscorpionidean—fauna Israels and einigen Angrenzender Gebiete. *Israel J. Zool. 12*: 184-212.

———— (1973): Pseudoscorpionidea von Ceylon. *Ent. Scand. Suppl. 4*: 39-55.

MURTHY, V. A. AND ANANTHAKRISHNAN, T. N. (1977): Indian Chelonethi. *Oriental ins. Monogr. 4*: 1-210.

SIVARAMAN, S. (1979): Studies on some Indian Pseudoscorpions. Ph.D. thesis submitted to Madras University.

A NEW GENUS OF RUBIACEAE FROM GREAT NICOBAR ISLAND, INDIA[1]

N. P. BALAKRISHNAN[2]

(*With a text-figure*)

A new monotypic genus, *Jainia* Balakr. of Rubiacae from Great Nicobar Island in Bay of Bengal is described with illustrations. It differs from the nearest allied genus *Coptophyllum* Korth. mainly in being completely glabrous, in trimerous corolla with three stamens and erect stigmatic lobes.

The recent intensive botanical explorations in Andaman and Nicobar Islands by the newly established Regional Station of Botanical Survey of India at Port Blair yielded many new species and new records for Indian Flora, particularly from the little-explored Great Nicobar Island. This southernmost island in Andaman—Nicobar group is situated at about 200 km northwest of Sumatra between 6° 40′-7° 20′ N and 93° 30′-94° 00′ E. This island is largely hilly with the highest peak, the Mt. Thuiller rising to about 700 m above m.s.l. The island experiences very heavy rainfall, ranging from 250-350 cm per year spread over all the months of the year, with the least fall occurring in February-March and the maximum during June-December. It is almost completely covered with rich, dense, tropical evergreen forests except a few areas along the southeast and southwest coasts where settlements have sprung up recently. The flora of the island is largely Malesian with more than 65% of the species showing distribution extending to Malaysia and Indonesia. About 10% of the species are endemic.

During a recent trip to the Great Nicobar island, a species of Rubiaceae with white flowers in terminal heads was seen growing along shaded streamsides, in dense, evergreen forests. On examination it is found to be a new genus allied to *Coptophyllum* Korth. and is described and illustrated below.

Jainia gen. nov.

Pertinet ad Hedyotideas e familia Rubiacearum et proxime accedit *Coptophyllo* Korth., a qua tamen differt plantis glabris; bracteis involucralibus 4 vel 5; calycibus pentameris, glabris; corollis trimeris; staminibus 3, insertis ad bases corollarum; stigmatibus erectis.

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[2] Botanical Survey of India, Andaman—Nicobar Circle, Port Blair-744 102, India.

Plantae herbaceae vel suffrutescentes, glabrae, simplices vel raro semel ramosae, saepe decumbentes et radicantes ad nodos inferas. *Folia* opposita, decussata, petiolata, glabra, integra, herbacea, penninervia; stipulae interpetiolares, lanceolatae, integrae, glabrae, persistentes. *Inflorescentiae* terminales, paniculatae, capituliformes, globosae, glabrae; involucella 4 vel 5, ovata, glabra, alba; flores hermaphroditi, parvi, sessili, bracteolati, dispositi in cymis 1-3 floriferis, bracteatis, *Calyces* pentameri; tubi non eminentes trans ovaria; lobi 5, ovato-lanceolati, albi, glabri, persistentes. *Corollae* albae, trimerae, tubulares tubis supra media constrictis, externe glabrae et interne dense villosae ad fauces; lobi 3, valvati, erecti, externe glabri, interne dense villosi. *Stamina* 3, inclusa infra fauces, imo corollae tubo inserta; filamenta filiformia, glabra; antherae oblongae, obtusae, introrsae, basifixae, longitudinales dehiscentes. *Disci* annulari, 4-lobi, glabri. *Ovaria* bilocularia, placentis mediis septis affixis peltatis, ovulis numeris; styli erecti, glabri; stigmata crassa, ovoidea, erecta, inaequaliter bilobata, inclusa infra fauces. *Fructus* capsulares globosi, subovoidei, calycibus coronatis irregulariter dehiscentes ad bases, partibus apicalibus cadentibus atque operculis; semina numerosa, subglobosa, angulata, scrobiculata, rubrobrunnea.

Species typica sequens.

Jainia nicobarica sp. nov.

Suffrutex, 40-60 cm altus, glaber; caulis teretiusculus, 5-8 mm crassus, lignosis, glaber, e basi breviter repente ascendens, raro post anthesim decumbens et radicans, simplex vel parce ramosus. *Folia* oblanceolata, basi leviter oblique cuneata, apice acuta, 14-25 cm longa, 3-5 cm lata, supra glabra et atrovirentia, infra pallide viridia et sparse puberula; nervi laterales 16-20 binati, recavi et anastomosentia ad marginem, infra prominentes; costa infra porcata; petioli 1-2 cm longi, glabri; stipulae lineari-lanceolatae, latae ad bases, longi-acuminatae, 1.3-1.6 cm longae, 2-3 mm latae ad bases, glabrae, persistentes. *Inflorescentia* globosa, capitata, 2.0-2.5 cm diam.; pedunculus 1-3 cm longus, glaber; bracteae involucrales 4-5, ovatae, triangulares, acutae, 7-8 mm longae, 4-6 mm latae, glabrae, crassae, carnosae, albae; bracteae cymarum albae, ovato-lanceolatae, 5-8 mm longae, 2-4 mm latae; bracteae florales lineari-lanceolatae vel oblongi-lanceolatae, 3-5 mm longae, 1-3 mm latae, albae, extra puberulae. *Calycis* lobi ovato-lanceolati, acuti vel subacuti, erecti, subaequales, 1-2 mm longi, ± 1 mm lati, minute puberuli ad apicem, carnosi, albi, persistentes, accrescentes usque ad 4 mm longos in fructibus. *Corolla* alba, tubulares, 3-4 mm longa, extra glabra, intra dense longe villosa ad faucem; lobi 3, valvati, ovati, ± 1 mm longi, carnosi, erecti, incrassati ad margines intra villosis. *Stamina* 3, inclusa, raro accedentia usque ad faucem corollam; filamenta filiformia, ± 0.75 mm longa; antherae oblongae, ± 0.75 mm longae, apice obtusae, basi breviter emarginatae. *Ovarium* calyce perfecte connatum, album; stylus ± 0.5 mm longus; stigmatis lobi ± 0.5 mm longi, oblongi, ovoidei, dense papillosi. *Capsula* oblonga, ovoidea, 7-8 mm longa, 5-6 mm lata, tenuipariete; semina numerosa, ± 0.4 mm longa, scrobiculata, alveolata, rubro-brunnea.

TYPUS: Insula Nicobar Magna, *Balakrishnan* 5837 A (holotypus in CAL); *ibid*. 5837 B-C (isotypi in PBL).

Jainia gen. nov.

Belongs to Hedyotideae of family Rubiaceae and is related to the genus *Coptophyllum* Korth. but differs in plants being glabrous; bracts of involucre 4 or 5; calyx pentamerous,

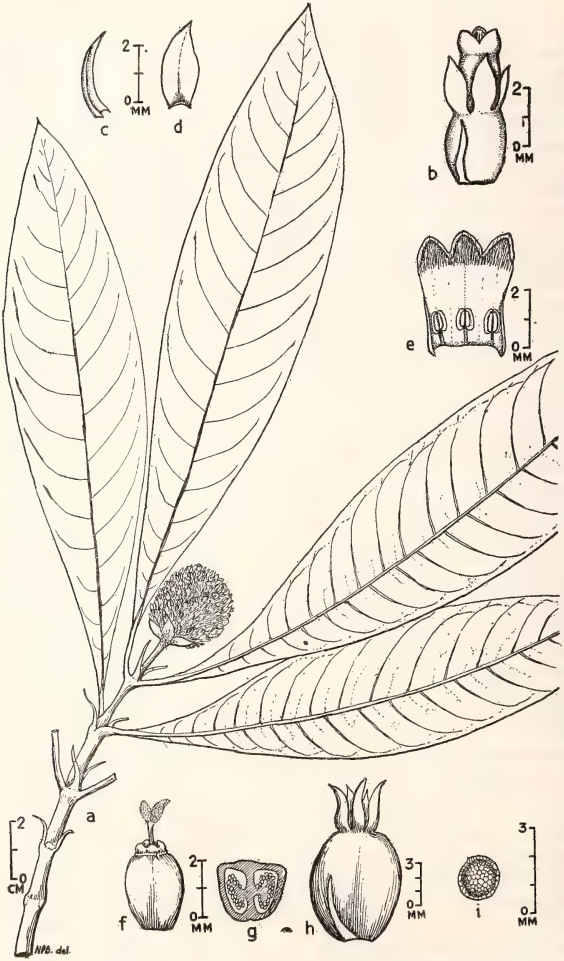
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Fig. 1. *Jainia nicobarica* sp. nov.; a. habit; b. flower with bract; c. & d. involucral bracts, side and inside views; e. corolla, split open showing stamens; f. ovary with disc, style and stigma; g. t.s. of ovary; h. fruit; i. seed.

glabrous; corolla trimerous; stamens 3, inserted at base of corolla-tube; stigma erect.

Herbs or undershrubs, glabrous, unbranched or rarely once branched, often decumbent or rooting at nodes below. *Leaves* opposite, decussate, petiolate, glabrous, entire, herbaceous, penninerved; stipules interpetiolar, lanceolate, entire, glabrous, persistent. *Inflorescence* terminal, pedunculate, capituliform, globose, glabrous; involucral bracts 4 or 5, ovate, white, glabrous; flowers bisexual, small, sessile, bracteolate, arranged in cymes of 1-3 flowers, bracteate. *Calyx* pentamerous; tube not projecting beyond ovary; lobes 5, ovate-lanceolate, white, glabrous, persistent. *Corolla* white, trimerous, tubular with tube constricted above the middle, glabrous outside, densely villous at throat inside; lobes 3, valvate, erect, densely villous inside. *Stamens* 3, included below throat, inserted at bottom of corolla-tube introrse, basifixed, longitudinally dehiscing. *Disc* annular, 4-lobed, glabrous. *Ovary* bilocular with peltate axile placentae fixed to middle of septa; ovules many; style erect, glabrous; stigma thick, ovoid, erect, unequally 2-lobed, included below the throat. *Fruit* capsular, globose, subovoid, crowned with calyx, irregularly dehiscing at base with the apical part falling off as a lid; seeds many, subglobose, angular, scrobiculate, red-brown.

Type species follows:

Jainia nicobarica sp. nov.

Undershrub, 40-60 cm high, glabrous; stem somewhat terete, 5-8 mm thick, woody, glabrous, shortly ascending from base, sometimes decumbent and rooting at base after flowering, simple or rarely branched. *Leaves* oblanceolate, slightly obliquely cuneate at base, acute at apex, 14-25 cm long, 3-5 cm wide, glabrous and dark green above, pale green and sparsely puberulous beneath; lateral nerves 16-20 pairs, arched and anastomosing at margins, prominent beneath; midrib ridged beneath; petioles 1-2 cm long, glabrous; stipules linear-lanceolate, broad at base, long-acuminate, 1.3-1.6 cm long, 2-3 mm broad at base, glabrous, persistent. *Inflorescence* globose, captitate, 2.0-2.5 cm diam.; peduncle 1-3 cm long, glabrous; bracts of involucre 4-5, ovate, triangular, acute, 7-8 mm long, 4-6 mm wide, glabrous, thick, fleshy, white; bracts of cymes white, ovate-lanceolate, 5-8 mm long, 2-4 mm wide; floral bracts linear-lanceolate, or oblong-lanceolate, 3-5 mm long, 1-3 mm wide, white, puberulous outside. *Calyx* lobes ovate-lanceolate, acute or subacute, erect, subequal, 1-2 mm long, ± 1 mm wide, minutely puberulous at apex, fleshy, white, persistent, enlarged up to 4 mm long in fruits. *Corolla* white, tubular, 3-4 mm long, glabrous outside, densely villous inside at throat; lobes 3, valvate, ovate, ± 1 mm long, fleshy, erect, thickened at margins, villous inside. *Stamens* 3, included, rarely reaching up to throat of corolla; filaments filiform, ± 0.75 mm long; anthers oblong, ± 0.75 mm long, obtuse at apex, shortly emarginate at base. *Ovary* united completely with calyx, white; style ± 0.5 mm long; stigmatic lobes ± 0.5 mm long, oblong, ovoid, densely papillose. *Capsules* oblong, ovoid, 7-8 mm long, 5-6 mm wide, thin-walled; seeds numerous, ± 0.4 mm long, scrobiculate, reticulate-alveolate, red-brown.

INDIA. Great Nicobar Island: Near 15 Km on East-West Road, dense evergreen primary forests, shaded moist places near streams, ± 75 m above m.s.l., 16 June 1977, in flower and fruit, *Balakrishnan* 5837 (holotype 5837 A in CAL and isotypes 5837 B-C in PBL).

Jainia differs from all other Rubiaceae mainly in the presence pentamerous calyx, and trimerous corolla with three stamens, a combination unknown or extremely rare in

TABLE 1

Coptophyllum Korth., nom. cons.	*Jainia* gen. nov.
1. Plants with stiff hairs on all young parts, especially leaf margin, stipules, bracts and calyx-lobes.	1. Plants glabrous throughout, except corolla-tube inside.
2. Involucral bracts 4, 5 or 8, never mixed in same species.	2. Involucral bracts 4 or 5, mixed in same species.
3. Corolla 4-5 lobed.	3. Corolla 3-lobed.
4. Corolla-lobes stellately spreading.	4. Corolla-lobes erect.
5. Corolla hairy outside on midrib.	5. Corolla glabrous outside.
6. Stamens 4 or 5.	6. Stamens 3.
7. Anthers apiculate.	7. Anthers obtuse.
8. Filaments attached to the middle or below the middle of corolla-tube.	8. Filaments attached to the base of corolla-tube.
9. Stigmatic lobes rectangularly spreading.	9. Stigmatic lobes erect or suberect.
10. Stigmatic lobes protruding out of corolla-tube.	10. Stigmatic lobes included, reaching up to the mouth of corolla-tube.

the family. However undoubtedly this new genus is closely related to *Coptophyllum* agreeing with it in general habit, terminal capitate inflorescence with involucral bracts and sessile flowers, many-ovuled ovary, and in the dehiscence of fruits. Reference to literature on this genus including the revision by Bremekamp (in J. Arn. Arb. 28: 189. 1947) under the synonymous generic name *Pomazota* Ridl. and study of specimens in Calcutta and Leiden herbaria show several distinctive features which distinguish this new genus from *Coptophyllum* as tabulated in Table 1.

The genus is named in honour of Dr. S. K. Jain, Director, Botanical Survey of India, for his valuable contributions to the taxonomy of Indian flora during the last 30 years.

ACKNOWLEDGEMENTS

I gratefully acknowledge the help rendered by the Director and his colleagues at Rijksherbarium, Leiden in comparing the new genus with specimens of *Coptophyllum* and allied genera and for their valuable opinion.

A NEW SPECIES OF *LINDENBERGIA* (SCROPHULARIACEAE) FROM EASTERN INDIA[1]

J. K. Sikdar and G. G. Maiti[2]

(*With four text-figures*)

Lindenbergia titensis sp. nov. (Figs. 1-4)

Lindenbergia titensis Sikdar et Maiti arcte affinis *L. macrostachyae* Benth. sed bracteis ovatis, calyce longioribus, lobis calycis ovatis, corollae labio postico obovato, ovaris basique styli dense piloso, facile distinguenda. *L. philippensi* (Cham.) Benth. persimilis, a qua differt bracteis elliptico-ovatis, lobis calycis ovatis acutis, ovaris dense piloso.

Herba perennis, deorsum lignosa. Caulis 50-60 cm longus, perramosus, rami adscendentes, graciles, teretes, pubescentes, saepissime ad apicem. Folia 2.5-8 × 1-2.5 cm, opposita, vel suprema alterna, elliptico-lanceolata, acuta, dentata, dentibus acuminatis, basi acute cuneata, supra glabrescentia, infra pilosa vel glabrescentia, nervis prominentibus, petiolis linearibus, 0.5-2.5 cm longis. Racemus 3-8.5 cm longus, terminalis axillarisque, penitus parum pubescens. Flores multi, alterni et suboppositi, sessiles vel brevissime pedicellati, flavidi, aggregati in racemo compacto tantum ad apicem (2-3 cm), aliter laxe dispositi. Bracteae 5-9 × 3-5 mm, foliaceae, elliptico-ovatae, acutae, denticulatae, calyce longiores, utrinque pilosae. Calyx parum dimorphus, 3.5-4 mm longus, 2-3 mm diametro, 5-lobatus, ca 2/3 connatus, 1/3 liberus, utrinque pilosus, quoque lobus 2 × 2 mm, ovatus, acutus. Corolla bilabiata, tubo 6-7 mm longo, 2-2.5 mm diametro, cylindrico, extus pubescenti, labrum posticum 2.5-3 × 2.5 mm, obovatum, retusum, cum 2 lobis parum angulatis, labium anticum 5.5-6 × 3 mm, apice 3 lobatum, lobis rotundatis, patentibus, obtusis, intus ad medium minute pilosis. Stamina 4, didynama, libera, inclusa, filamentis 4-4.4 mm longis, 2 mm supra basim corollae insertis, glabris, filiformibus, thecis subglobosis, 0.3 mm diam., connectivis 0.3 mm longis. Ovarium 2.5 × 2-2.5 mm, subglobosum, dense pilosum, stylo 3 mm longo, lineari, solum ad basin piloso. Capsula matura non visa.

Holotypes lectus a J. K. Sikdar ad locum Titi in area sylva Madarihat, regione Jalpaiguri, Benghala occidentale, die 5-3-1976, et positus in herbario indico nationali (CAL), sub numero 4519A. Isotypi 4519 B-C positi in eodem herbario.

Lindenbergia titensis sp. nov.

It is closely allied to *L. macrostachya* Benth., but is easily recognisable by ovate leafy bracts, bracts longer than calyx, ovate calyx lobes, obovate posterior lip of corolla and finally ovary and style base densely hairy. It is also very similar to *L. philippensis* (Cham.) Benth. from which it differs in having elliptic-ovate bract, ovate, acute calyx lobes and densely pilose ovary.

Perennial herbs, woody below. Stem 50-60 cm long, slender to stout, many branched; branches ascending, slender, terete, pubescent, more often at the apex. Leaves 2.5-8 × 1-2.5 cm, opposite or the uppermost alternate, elliptic-lanceolate, acute, dentate, teeth acuminate, base acute-cuneate, upper surface glabrescent, lower surface pilose or glabrescent

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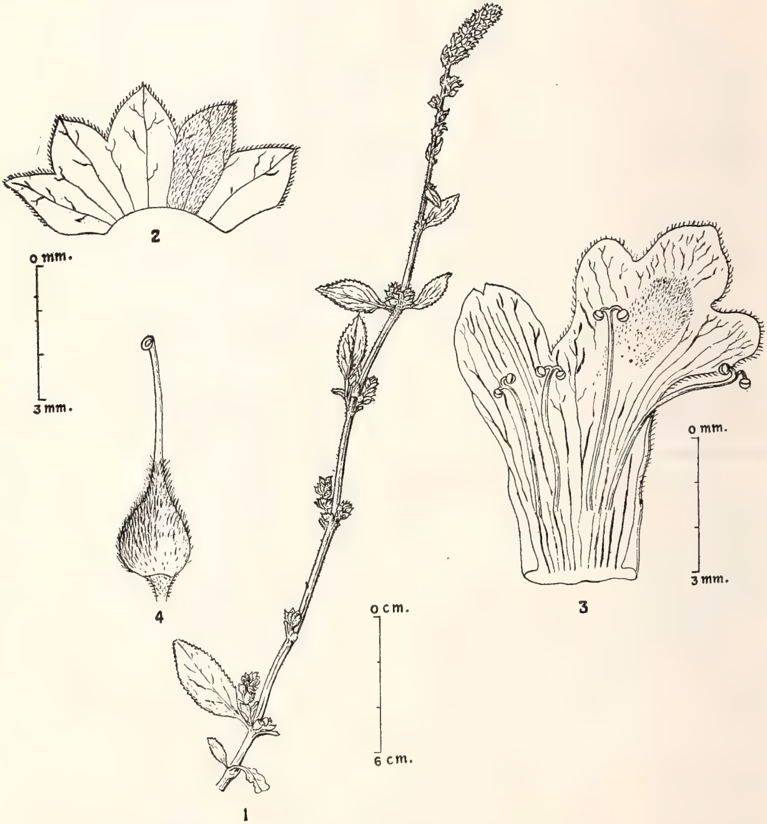
[1] Accepted March 1980.

[2] Central National Herbarium, Botanical Survey of India, Howrah-711 103.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Figs. 1-4. *Lindenbergia titensis* sp. nov.: 1. Plant habit; 2. Calyx; 3. Corolla split open and 4. Carpel.

or pubescent, nerves distinct on the undersurface; petiole 0.5-2.5 cm long, linear. Racemes 3-8.5 cm long, terminal and axillary, slightly pubescent throughout. Flowers many, alternate and subopposite, sessile or very shortly pedicillate, yellowish, aggregate into a compact raceme only at the terminal (2-3 cm) position, otherwise loosely arranged. Bracts 5-9 × 3-5 mm, uppermost leaves gradually passing upwards to bracts, foliaceous, elliptic-ovate, acute, denticulate, longer than calyx, pilose on both surfaces. Calyx slightly dimorphic, 3.5-4 mm long, 2-3 mm diam., 5-lobed, about 2/3 part united and 1/3 free, pilose on both surface; each lobe 2 × 2 mm, ovate, acute. Corolla bilabiate, tube 6-7 mm long, 2-2.5 mm diam., cylindrical, pubescent at the outer suface, posterior lip 2.5-3 × 2.5 mm, obovate with 2 slightly angular lobes, retuse; anterior lip 5.5-6 × 3 mm, apex 3-lobed, lobes rotundate, spreading, obtuse, minutely hairy at the middle inside. Stamens 4, didynamous, free, included; filaments 4-4.5 mm long, inserted 2 mm above the corolla-base, filiform, glabrous; thecae subglobose, 0.3 mm diam., connective 0.3 mm long. Ovary 2.5 × 2-2.5 mm, subglobose densely pilose; style 3 mm long, linear, pilose at base only. Mature capsule not seen.

Holotype, *J. K. Sikda*r 4519A (CAL) and the isotypes *J. K. Sikdar* 4519B-C (CAL) were collected from Titi, Madarihat Forest Range, Jalpaiguri District, West Bengal on 5-3-1976.

The specific epithet is derived after the name of the locality "Titi" from where it was collected.

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We are grateful to Dr. M. P. Nayar, Deputy Director, Central National Herbarium for facilities, to Prof. R. S. Rao of Andhra University for encouragement and to Dr. N. C. Majumdar, Central National Herbarium, Howrah, for Latin translation and helpful suggestions.

MISCELLANEOUS NOTES

1. NOTES ON THE MATING BEHAVIOUR OF *TADARIDA AEGYPTIACA* (GEOFFROY)

INTRODUCTION

This paper presents an observation on mating made in the course of a study of the reproductive cycle of this species in East-Nimar. Copulation was witnessed many times at the roost and a few instances occurred in cages also.

Since little has been published on this aspect of Indian Molossid bats, this study was undertaken to collect data on mating period of *Tadarida aegyptiaca* in East-Nimar of India.

OBSERVATIONS

The species is locally scarce in East-Nimar. Three colonies were observed, one in a building and the other two in two dilapidated forts. The portion of the building where these bats roost, is being used as a class room. The forts are ancient monuments in Asirgarh and Burhanpur looked after by the State Archeological department. Over five thousand bats roosted in the three colonies from June till the second week of April the following year. They reside in crevices vertical about 8 feet in length and three inches in width. The number of bats at the three roosts decreases during the hot weather but several hundreds occur during the other seasons.

During the years 1975 to 1977 the roosts were vacated from the second week of April upto the month of May. On their return the females were examined and were not found pregnant. Ovulation occurs between the second and third week of June. The strength of the colony increases as new arrivals appear daily. The bats are noisy and their squeaking and chattering at the roost is audible at a considerable distance.

The bats roost in a typical pattern in which they appear as if they have been arranged in orderly straight lines of ten to forty bats. In the total population of bats, hundreds were noticed copulating but observation was limited to 50% of the total population of bats at Burhanpur and Asirgarh. This investigation lasted five to ten hours a day but not at night.

In the estimated population during 1976 and 1977, the sex ratio was approximately 40% males and 60% females. Mating was noticed during day light when males and females were quite active. The majority of males collected at this time had scars on or around the muzzle region. Apparently these injuries resulted from aggressive interactions with other males and possibly females also.

The male mounted on the female in the position of coitus posteriori. The male usually grasped fur of the female's head with his teeth. However, in a few instances the neck was grasped by the male. The male's thumb was always inside the dactylopatagium brevis of the female. The male pushed his hindquarters backwards and forwards making an angle of 20° on female's body in the plane of coitus. The tail of the female including its femoral membrane was curled upwards and the male protruded penis beneath her femoral membrane. After copulating with one female, the male often holds another female. Immediate dissection and histological studies by fixation and microscopic examination after copulation revealed that female's uterus and vaginal canal were filled with sperms.

The male does not pay any attention to the rival bats during copulation. Males were observed fighting with each other, squeaking and showing their teeth to opponents. The female was passive.

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May 4, 1979.

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I am grateful to Prof. D. R. Sharma for suggestions. My thanks are due to the Head, Department of Zoology, S. N. College, Khandwa for providing facilities for this investigation. The financial assistance offered by the University Grants Commission, New Delhi is gratefully acknowledged.

S. K. KASHYAP

2. FIELD OBSERVATIONS ON THE HANUMAN LANGUR

Some 20 hours of observations (mostly before noon) were made on langurs (*Presbytis entellus*) of the Mudumalai Wildlife Sanctuary (Tamilnadu) during February and March 12, 1978. The Sanctury is situated at an altitude of 885 m on the way of Mysore-Ooty road and is 95 km from the Mysore. The forest is moist-deciduous with 'Teak', *Tectona grandis* as the dominent species.

There were five groups of the langur in an area of about 2 km². Two groups were multimale-bisexual and three groups were unimale-bisexual type. There was no all-male group. The composition of the groups as given in Table-1 reveals that adult sex ratio was male 1:6 females; adult female to infants (new born) ratio was female 1:0.47 infants. The age-classification of the individuals followed is

Table 1

Group composition of the Hanuman langur

Group	Total	Adult males	Adult females	Subadults and Juveniles	Infant-2	Infant-1
1. Mudum-B	18	1	10	2	0	5
2. Mudum-E	17	1	9	3	2	2
3. Mudum-H	21	1	8	4	4	3
4. Mudum-S	22	3	9	2	2	6
5. Mudum-L	28	2	12	4	3	7
Total	106	8	48	15	11	23
Mean	21	1.6	9.6	3	2.2	4.6
Range	17–28	1–3	8–12	2–4	0–4	2–7

according to Jay (1965).

The mean group size is similar to size recorded by Jay (1965), 18-25 in forests of northern and central India; Vogel (1977), 23.5 in Bhimtal, while it was larger (34 for bisexual groups and 18.5 for all male groups) in open areas of Western Rajasthan (Mohnot *et al.*, in press). There was no apparent interaction among the adult males of the multimale bisexual groups and also between the two neighbouring groups.

Langurs are purely phytophagus and eat leaves, flowers, buds, fruits, seeds and resin of some 30 plant species (to be identified). Some of the common food plants were *Anogeissus latifolia, Butea monosperma, Salmalia malabarica, Dalbergia sissoo, Schleichera trijuga, Mangifera indica, Terminalia chebula* etc.

The bonnet monkey, *Macaca radiata* coexists freely with the langurs and almost use the same plants for feeding and roosting. The langur avoids the bonnet macaques but hit out, whenever they are disturbed by the macaques.

The langurs are afraid of Pie dogs and give alarm barks and climb trees, whenever they see dogs approaching them. On 6th March (9.05 a.m.) a pack of 6 pie dogs chased a langur group which was crossing the road. The leader of the langur group threatened the dogs but was bitten on his right ear.

Langurs were seen in an association with Chital (*Axis axis*) in the Bandipur Tiger Reserve, adjacent to Mudumalai. Both species were noted together or Chitals fed under the same tree on which langurs were feeding. Occasionally langurs were seen sitting on the ground near browsing chital. On 5th March (6.40—6.52 p.m.) we saw langurs and chitals giving repeated alarm calls together, probably there was a common predator (?).

ACKNOWLEDGEMENT

We are indebted to Prof. Madhav Gadgil, Indian Institute of Science, Bangalore for providing working facilities.

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REFERENCES

JAY, P. O. (1965): The common langur of North India. *In* Primate Behaviour: field studies of monkeys and apes. ed. I. DeVore. pp. 197-247. Holt, Rinehart and Winston, New York.

MOHNOT, S. M., GADGIL, M. AND MAKWANA, S. C. Population dynamics of the langur, *Presbytis entellus* at Jodhpur. (in press).

VOGEL, C. (1977): Ecology and sociobiology of *Presbytis entellus. In* Use of non-human primates in biomedical research eds. M. R. N. Prasad and T. C. Anand Kumar. Indian nat. Sci. Acad., New Delhi, India.

3. A NOTE ON THE BREEDING OF THE LEOPARD-CAT (*FELIS BENGALENSIS*) IN CAPTIVITY

The female of a pair of Leopard-Cats (*Felis bengalensis*) has given birth to four litters at Nandankanan Biological Park, Orissa. The litter size was one to two with an average of 1.75 kittens per litter. There were four females and three males. The four births were recorded as follows: February, 1; March, 1; May, 1; and July, 1. At birth the seven kittens weighed 93 to 120 g with an average of 113.14 g and measured 22 to 25 cm with an average of 24.14 cm tip to tip including tail lengths of 6.5 to 7 cm (average 6.86 cm). The inter-parturition intervals recorded thrice (Dates of births: 26.ii.1977, 19.v.1977, 21.iii. 1978 and 4.vii.1978) were 81 days, 305 days and 104 days respectively mostly depending on the period of survival of the young. The mother leopard-cat weighed 2.805 kg and the male weighed 3.605 kg on 8.iii.1977. The mother used to carry the kittens like other cats. The eyes of the new-born kittens were closed at birth and the details of opening of eyes of five kittens under observation are given in the Table 1.

TABLE 1

Sl. No.	Sex	Date of birth	Dates of opening of eyes	Age in the days when the eyes of the kittens opened
1	2	3	4	5
1.	Female	19.v.1977	31.v.1977 (Left eye) and 1.vi.1977 (Right eye)	13th (Left eye) and 14th (Right eye)
2.	Female	19.v.1977	26.v.1977 (Right eye) and 27.v.1977 (Left eye)	8th (Right eye) and 9th (Left eye)
3.	Female	21.iii.1978	31.iii.1978 (Left eye) and 1.iv.1978 (Right eye)	11th (Left eye) and 12th (Right eye)
4.	Female	4.vii.1978	11.vii.1978 (Left eye) and 12.vii.1978 (Right eye)	8th (Left eye) and 9th (Right eye)
5.	Male	4.vii.1978	14.vii.1978 (Right eye) and 15.vii.1978 (Left eye)	11th (Right eye) and 12th (Left eye)

TABLE 2

Date	Age in weeks	Weight in kg.
1	2	3
19.v.1977	Birth weight	0.120
26.v.1977	1	0.182
2.vi.1977	2	0.232
9.vi.1977	3	0.294
16.vi.1977	4	0.385
23.vi.1977	5	0.430
30.vi.1977	6	0.570
7.vii.1977	7	0.695
14.vii.1977	8	0.845
21.vii.1977	9	0.945
28.vii.1977	10	1.073
4.viii.1977	11	1.156

The canines of two kittens under observation appeared at the age of four weeks. Weekly growth records of one female kitten born here on 19.5.1977 was maintained upto the age of 11 weeks and the details of the same are given in the Table 2.

Prater (1971) states that the young of this species have been obtained in March and May and 3 to 4 kittens may be born in a litter. In India, this species mates in May and has 3 to 4 young per litter after a gestation period of 56 days (Asdell 1964).

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REFERENCES

ASDELL, S. A. (1964): Patterns of Mammalian Reproduction. Second Edition, Cornell University Press, Ithaca, New York, pp. 490.

PRATER, S. H. (1971): The Book of Indian Animals. Third (Revised) Edition, Bombay Natural History Society, Bombay, pp. 73-74.

4. DO LEOPARDS USE THEIR WHISKERS AS WIND DETECTOR?

I had an apportunity to witness a peculiar behaviour of a big male Leopard in the hilly tract of Udaipur.

My father and we three brothers were sitting on a hillock and admiring four sambar (*Cervus unicolor*) does and two grown up fawns grazing peacefully in a clearing on the face of a hill about 200 yards from us. Between us and the sambar, there was a belt of scrub jungle and beyond there was dense jungle. They were on a higher ground from us. We were engrossed in watching when suddenly my elder brother caught sight of a leopard in a depression, between us and the hinds about 80 yards from us, stalking them. A good breeze started from our direction towards the hinds. When the leopard was about 70 yards from them and almost level with us the does became uneasy. He crouched there for about five minutes occasionally raising and slightly turning his head sideways, his whiskers taut and relaxed alternately, which I could see clearly with the help of binoculars. Then the leopard turned and retreated for about 30 yards towards our right side and disappeared, reappearing again over the bank of a dry nullah and started stalking over a comparatively barren ground. Soon he was detected by a hind, she advanced two or three steps towards the leopard followed by two other hinds, gave a loud bell and all of them dashed into the dense jungle. The leopard rose from his position took two steps, raised his tail, gave a woogh call and went off.

From this incidence I inferred that these big cats know the importance of wind and use their whiskers as a tool to detect wind direction.

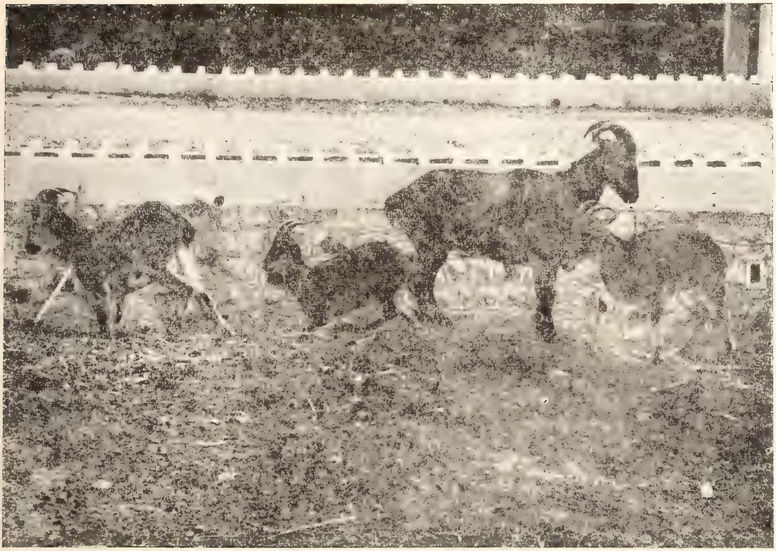
I would therefore be grateful if some naturalist throws more light on the matter.

41 PANCHWATI,
UDAIPUR-313 001 (INDIA),
June 25, 1979.

RAZA H. TEHSIN

5. NILGIRI TAHR (*HEMITRAGUS HYLOCRIUS*) IN CAPTIVITY

(*With a photograph*)



Nilgiri Tahr at Trivandrum Zoo.

One adult male was transferred to Trivandrum Zoo, from Trichur Zoo on 9.9.1964. A female was added on 29.9.1965 and another on 13.12.1967. Four offsprings were born on the following dates, 4.2.68, 5.11.68, 1.5.69 and 11.12.69. The first one died on 1.4.69 and the last on 30.1.72. The second was exported and the third was supplied to the Mysore Zoo.

The original male died on 21.3.72 and the female on 10.8.69. The other female was also exported.

During this period only the original male developed the saddle mark. As I was observing the animal every day, it is difficult for me to state with precision when it started developing the saddle. The saddle becomes noticeable very gradually. It may be from 5 to 8 years.

The food given to adults per day is as follows: Bengalgram 100 gms, Cattle feed 500 gms, Horsegram 200 gms, Plantains 500 gms, Fodder 2.5 kg., and Napier Grass 5 kgs.

In the Zoo the tahr enjoy concentrates more than green fodder. They like the fodder to be tied above ground level so that they can browse.

I have not seen them drinking during my visits to their run. They seldom drink.

On 22.1.76 one pair of tahr aged 1 month was caught at Eravikulam and these are doing well. I have seen them mating recently. However, the mating has not been successful.

SUPERINTENDENT,
ZOOS & GARDENS,
TRIVANDRUM-1,
September 14, 1979.

P. R. CHANDRAN

6. A FURTHER NOTE ON *MOSCHUS*

Since contributing a note on the taxonomy of *Moschus* to this *Journal* (Groves 1976) the author has seen a number of further specimens which was unavailable to the author at that ranges, both geographical and altitudinal, of the two species in the Indian region. A taxonomic contribution by Dao van Tien (1969), which should be recorded as they extend the time, should also be evaluated now.

Two species of Musk-deer are found in Indian and Nepalese territory: *M. sifanicus* has light brown fur, the backs of the ears are rimmed with pure yellow, the skull length averages about 160 mm, and the lacrimal bone is long and low; *M. chrysogaster* has dark brown fur, the ear-backs are wholly dark, the skull length is about 150 mm, and the lacrimal is relatively short and high. The former, which lives above the tree-line, is represented in China by a race in which the whole tip of the ear, not just the rim, is yellow, but which is otherwise poorly distinguished and is an any case unnamed; the latter species, which lives in forest and is represented in India and Nepal by its nominate form, is smaller and short-faced, though it was pointed out that in fact two subspecies would probably be better recognised in China (see below).

It must be mentioned that in the table of skull measurements (Groves, 1976:674), there is a misprint. Two headings read "*M. sifanicus*": only the second of these is correct, the first being a lapsus for "*M. c. chrysogaster*".

The additional specimens examined are as follows:

1. M. sifanicus

Two skins, one skull and a headskin in the Powell-Cotton Museum, Birchington, Kent, England. T.31.2 is a skin and skull; the skin is light tobacco brown, fading to off-white on head, shoulders and again on rump. The ears are yellow-rimmed. Skull broken, but its length is approximately 160, lacrimal 21 x 14; midpoint of skull probably in orbit. Locality is Baital, Kashmir (not found on any map). The other complete skin (no number) and the headskin (M.46.99) have no locality beyond "Kashmir", but are clearly of this species.

2. M. chrysogaster chrysogaster

The Powell-Cotton Museum possesses an incomplete skull that is probably of this form, numbered T.31.3, from Srinagar, which (if it is the actual locality rather than a base camp) is in the forest zone. The length would have been about 145 mm.; lacrimal 23 x 20; midpoint would have been approximately at the front edge of the orbit.

The Zoological Survey of India, Calcutta, has three specimens: two skins with skulls (see Biswas & Khajuria, 1957) and unmatched skin. The first two are nos. 12448 and 12449, of the "Daily Mail" expedition, 1954; localities respectively Thami and Hunko, both at 13,000 feet but, because of the protected locations, in the forest zone (mainly rhododendron and juniper). Skins are dark brown with ear-backs dark, becoming nearly black towards the tips. The skull of the former is 145 mm. long, with lacrimal 25 x 19; the other specimen is immature, with third molars not yet erupted, but skull length is 140, lacrimal 23 x 15. In both, skull midpoint is well within the orbit. The metacarpal length of 12448 is 93.5, metatarsal length 126; both these measurements are slightly above the figures for *M. c. berezovskii* given by Flerov (1952) and Kao (1963), but well below the limits for *M. sifanicus* given by the same authors. The third skin, no. 12451 from Khumbu, 12,000 feet, closely resembles the other two.

Two head-skins and a partial skull are preserved in the palace at Wankaner, Gujarat; they were obtained by M. K. Ranjitsinh at Shodu, Bhutan (in the rhododendron zone), and are the only known specimens from Bhutan. The head-skins are very dark grey-brown, the ears being dark especially on the terminal half. The skull, which may belong with one of the skins, is incomplete but is clearly short-faced.

The importance of the above specimens is that they confirm the distinctiveness of the two species, the association of skull and skin characters, where both are represented for the same specimen, being demonstrated; and that they confirm the association of each with a different habitat type, even when the forest zone extends to a higher altitude than usual.

A recent paper by Dao (Dao 1977) refers to a taxon, *Moschus moschiferus caobangis* Dao, 1969, from North Vietnam and provides the first description of this in French (the original description being in Vietnamese). Dao's papers were based on the old single-species theory, and clearly written without knowledge of Groves's revision, but neatly extend the results. It is clear from the description that *cao-*

bangis is Groves's "*M. chrysogaster* subsp." recorded from Kwangsi, to which the British Museum specimens from Ichang also probably belong:

(1) Dao's new race is described as "brun grisatre", which approximately describes B.M.1.3.2.6 from Ichang; Wang *et al.* (1962) describe a specimen from Kwangsi as "brown". Skins of ***M. c.*** *berezovskii* from Szechwan, Kansu, Shensi and Shansi are described as darker than this ("dark olive-brown with a red tinge" in Kao, 1963, which describes B.M.3.5.15.6 and 11.9.8.144, both from Szechwan).

(2) Skulls in two *caobangis* are 113 and 132 mm. long; the second of these, the type, is figured, but it is not stated whether the other is adult or not. Kao's (1963) Kwangsi skull is 121 mm., whereas all his and other authors' other *berezovskii* skulls are at least 136 mm. Wang *et al.* (1962) report a Kwangsi skull as being 116.7 mm, but this may actually mean the basal length; it is, at any rate, short. The Ichang skulls in the British Museum are 135 and 141 mm, so overlapping with one of Flerov's (1952) specimens, whose age is however not stated. (The locality "Peling Mts.", whence comes a rather large skull, is probably not Mt. Pai Ling in Kwangsi as surmised by Groves (1976), but the Pai-Lung Chiang in southern Kansu.)

The light colour probably, and the small size definitely, validate Dao's subspecies; it extends into Kwangsi and probably even as far as Ichang. *M. moschiferus caobangis* Dao, 1969, and "*M. chrysogaster* subsp. uncertain" of Groves, 1976, therefore both become *M. chrysogaster caobangis.*

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I would like to thank all those who have specimens in their care which were made available to me for study: in Birchington, Mr. L. Barton, Curator of the Powell-Cotton Museum; in Calcutta, Dr. B. Biswas, Superintending Zoologist of the Zoological Survey of India, and all staff; in Wankaner, H. H. Maharana Saheb and M. K. Digvijaysinhji. I am most grateful to all these people for their courteous assistance in this study.

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REFERENCES

BISWAS, B. & KHAJURIA, H. (1957): Zoological results of the "Daily Mail" Himalayan expedition, 1954. Notes on some mammals of Khumbu, eastern Napal. *Proc. Zool. Soc. Calcutta, Mookerjee Memor. Vol.,* 229-253.

DAO VAN TIEN (1969): Ve hai loai huou o Viet nam, huou sao (*Cervus nippon*) va huou xa (*Moschus moschiferus*). *Thong bao khoa hoc, Sinh vat hoc, Dai hoc tong hop Ha noi, 4*:49-53.

——————— (1977): Sur quelques rares mammiferes au nord du Vietnam. *Mitt. Zool. Mus. Berlin, 53*:325-330.

FLEROV, C. C. (1952): Musk and deer. Fauna of USSR, Mammals, vol. 1.

GROVES, C. P. (1976): The taxonomy of *Moschus* (Mammalia, Artiodactyla), with particular reference to the Indian region. *J. Bombay nat. Hist. Soc.*, *72*:662-676.

KAO YEUH-TING (1963): Taxonomic notes on the Chinese musk-deer. *Acta zool. sinica, 15*:479-488.

WANG SUNG, LU CHANG-KWUN, DAO YUEH-TING & LOO TAI-CHUN (1963): On the mammals from south-western Kwangsi, China, *Acta zool. sinica, 14*:555-568.

7. REPORT OF THE OCCURRENCE OF THE METAD IN WEST BENGAL

In the afternoon of the 17th February, 1978, while digging rodent burrows in a harvested paddy field, south of Apurbapur village near Singur in Hugli District, we caught an adult female rat with five juveniles, which were identified as of the Soft-furred Field Rat or Metad, *Millardia meltada* (Gray).

The known distribution of *Millardia meltada* (Gray), is Bihar, Uttar Pradesh, Nepal Tarai, Punjab, Haryana, Rajasthan, Peninsular India south of the Satpura-Vindhya ranges, south to Nilgiris, south-western Sri Lanka, parts of Gujarat and the adjacent region of Pakistan, but does not include the north-eastern part of India (Assam, Meghalaya, Arunachal Pradesh, Nagaland, Manipur, Tripura and Mizoram), Orissa and West Bengal. The present collection, therefore, constitutes the first authentic record from West Bengal.

The details of the specimen is given below. The external measurements were taken in the field and are in mm.

Material: 1 ♀; ZSI Reg. No. 19935; in alcohol; 17.2.78; A. K. Mondal Coll.

Measurements: External—Head and body 111.0; tail 76.0; hind foot 22.0; ear 20.0.
Cranial—Occipitonasal 31.4; condylobasal 30.5; nasal 11.5; palate 16.4; bulla 6.1; tooth row 5.6; anterior palatine foramina 7.4; diastema 8.8.

In comparison with the recognised subspecies of *Millardia meltada* namely, the *Millardia meltada meltada* (Gray) and the *Millardia meltada pallidor* (Ryley), the present material is much darker. However, without examination of additional material nothing definitely could be said of its subspecific status.

ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET (1ST FLOOR),
CALCUTTA-700 016,
September 21, 1978.

AJOY KUMAR MANDAL
SANTANU GHOSH

8. SOME OBSERVATIONS ON THE BIOLOGY OF THE OPENBILL STORK, *ANASTOMUS OSCITANS* (BODDAERT), IN SOUTHERN BENGAL

(*With a plate*)

The Openbill Stork [*Anastomus oscitans* (Boddaert)] is the smallest and commonest stork of our country.

This paper reports on observations made in South Bengal in Saknakhali bird sanctuary in the Sundarban Reserve Forest, Sagar Island, Frazergunge and Diamond Harbour by the author from 1975 onwards.

The Openbill is a tree-nester. Generally it forms a huge breeding colony of its own but also nests in a breeding colony with other birds. In the Sajnakhali bird sanctuary, Sundarban, the breeding colony included such species as the large egret (*Egretta alba* Linn.), smaller egret (*Egretta intermedia* Wagler), little egret (*Egretta garzetta* Linn.), little cormorant (*Phalacrocorax niger* Vieillot), paddy bird [*Ardeola grayii* (Sykes)] and some others.

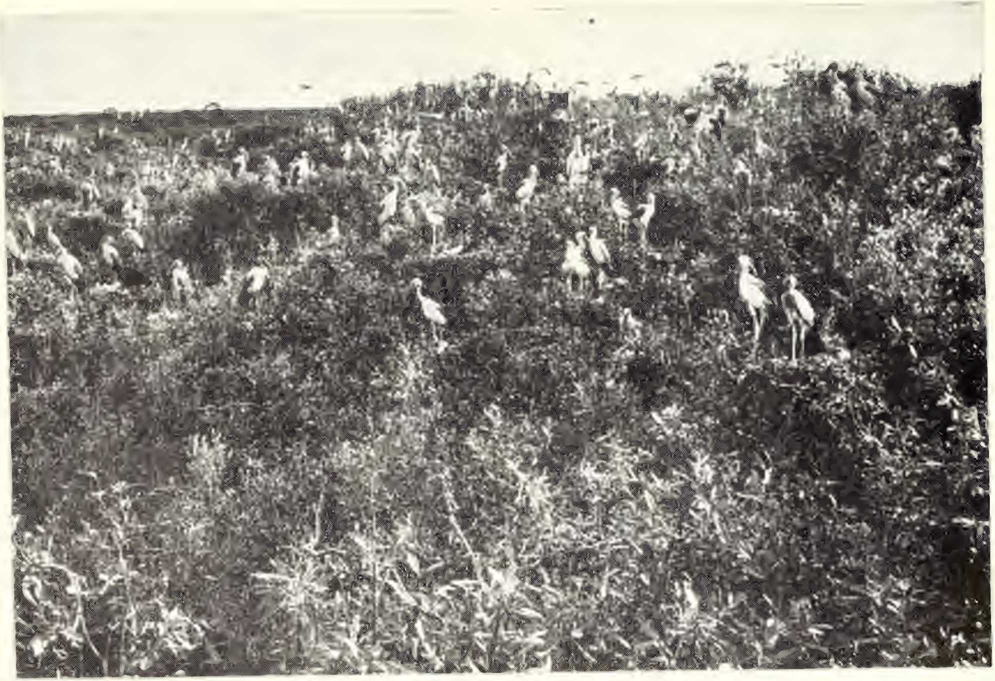
The situation and size of the breeding colonies depend to a great extent on the available marshy conditions, richness of feeding ground in the vicinity and non-interference by predators and man. Colonies have been found very close to human quarters, roads and railway stations, where birds are not disturbed or pestered. Some colonies are found in impassable marshes in dense forested area on isolated islands for safe raising of the brood.

PAIR FORMATION AND PAIR BOND

Since the male and female are almost alike in general appearance in the non-breeding period, sexes cannot be differentiated, but during the breeding period it becomes possible to distinguish them by their behaviour, specially the attitude of the male towards the female. The males are rather more aggressive quarrelling amongst themselves for nesting space than the females. At times, subadult males have been found courting adult females, but such females simply change their perch and pay little heed to them. Consort pairs are formed just before the monsoon starts. Such pairs often forcibly push each other which compels one of them to fly from the perch and again after a short flight return to occupy the same place in close proximity of its partner who waits for its mate. Courtship display is not very conspicuous. The male has been observed at times to throw its neck backward when the female returns from flight. After sometime the male stretches its neck up and partially opens its wings and bill. The male offers a stick to the female and if it is accepted by the female, it signifies approval of pair formation. In selecting the nesting site the male and female perform a ritual. They perch face to face, lower their heads and point at the nest-site with their bills partly open. After this act the pair flies away but returns to the spot. The same performance is repeated three or four times within an hour. When the site selection is finalised the male is also finally accepted by the female.

NEST-BUILDING, SEXUAL DISPLAY AND MATING

The bird selects trees that are from three to ten metres high. In Sundarban (Sajnakhali) most of the nests that I came across were hardly four to five metres from the ground level. The host plants selected for nesting were mostly Bina, *Avicennia alba* and *Avicennia officinalis*, which represented about 80 per cent of the plant community. These provided better support due to ramification of branches, and also the canopy provided wider landing space which generally varied from 9 to 16 square metres. The next choice was the Gengwa, *Excoecaria agallocha*, which represented roughly 15 per cent. Other trees that were sometimes selected were Passur, *Xylocarpus* sp., Goran, *Rhizophora* sp., and Kulsi, *Aegiceras* sp., but these were comparatively of small percentage. In Diamond Harbour, trees that were used for nesting were Jarul, *Lagerstroemia flosreginae*, Neem, *Melia azadirachta*, Peepul, *Ficus religiosa*, etc. It seems that the bird does not bother much about the height of the trees, some 10-12 metres height was mostly preferred, whereas in Sagar Island and



Intensive nesting area of the Openbill Stork in Sajnakhali Bird Sanctuary, Sundarban, West Bengal.

Frazergunge areas the nesting tree heights were only five to seven metres. Nesting sites were generally not changed in the following year unless there was disturbance in the area.

The tree-tops are the first choice of nesting site and when this is not available, alternative sites are selected further down. Generally tree-forks are the usual sites for nests. Trees which provide a good number of forks are preferred. Since the birds are gregarious, congregation is quite dense; naturally there is overcrowding and struggle for space. Nests may be 60 centimetres apart, but there is a good understanding between the breeding pairs in the colony. The male with nest-building material flies straight to the nest-fork, and as soon as it perches it drops the material, and the female which waits at the rim of the nest makes a guttural buzzing sound on the arrival of the male, and the freshly brought material is then properly arranged. The male erects the neck and exposes the breast feathers and produces a buzzing sound and both bend their heads over the nest. It is interesting to note that the sticks that are brought by one of the partners, generally the male, is examined by the other. During this process the material that falls down is not picked up. Sometimes the female rejects the material brought by her partner. In Sundarban heronry, as many as 30 trips per day were counted in connection with the nest-building operation during the whole day in the beginning but the trips were gradually cut off as the nest under preparation was half way to completion. After almost half the nest is ready the pairs mate usually in the late afternoon or any time on a cloudy day. The act is performed when the female settles herself on a branch near the nest. The male vigorously beats the beak of the female with his own, thereby producing a clattering sound which coaxes the female to bend her tail laterally to allow copulation.

It generally takes 11 days to complete the construction of a nest. Nest may be constructed even in late August. Sometimes when the nest prepared is destroyed by storms and gales, it is soon replaced by a fresh one.

The nest is a loose, flimsy, structure which generally does not last till the next season but those that withstand the rough weather are taken as foundations and fresh nest-building material is brought for their repair. In Sajnakhali and Frazergunge, soft and leafless branches of *Excoecaria, Avicennia* and sometimes branches of *Derris, Ceriops* and *Xylocarpus* species are added. Soft leaves brought by the male are properly arranged in the egg-chamber so as to prevent the eggs from dropping. Green leaves are from time to time added to replace the old dry ones in nests till the fledglings are ready to leave the nests. The size of nests vary largely. The circumferences of five nests measured 100-125 cm (average 113) in Sajnakhali.

The eggs are laid by the third week of June and egg-laying continues till the first week of August depending on the onset of monsoon. Generally three to five eggs are found in a nest but in two nests in Sajnakhali, Sundarban, only two have been found. Some nests were also found without any egg. Incubation period varies from 28 to 30 days. Regurgitation of water and mucous over eggs specially on dry rainless days has been observed. The parent birds also control the humidity by wetting their abdominal feathers to aid fermentation of nest material to help incubation.

PREDATION

Predation is largely by the Water Monitor (*Varanus salvator*) which is the most common species of reptile in Sundarban. It not only destroys eggs but also appropriates nestlings.

The lizards has been found to swim in creeks and climb trees to devour eggs and chicks. At the approach of the parent birds it jumps from trees and dives into the water. The land monitors, namely *Varanus flavescens* and *V. bengalensis*, also predate on eggs and chicks. Other than the *Varanus* species, the Jungle Crow (*Corvus macrorhynchos*) destroys eggs and steals chicks at the slightest opportunity. The mother guards her eggs while incubating from predators by partially opening her wings and bill, and tries to scare away the intruders, but a powerful predator like the water monitor compels the parent bird to leave the nest. Some birds of prey, namely the Pariah Kite, (*Milvus migrans*), Bonelli's Hawk Eagle (*Hieraaetus fasciatus*) and Pallas's Fishing Eagle (*Haliaeetus leucoryphus*) have been observed to fly over and snatch the nestlings at opportune moments.

THE REEACTION OF ADULTS AND FLEDLINGS TOWARDS INTRUDER

As soon as the adult birds become aware of the presence of an intruder, they react sharply by an escaping flight in flocks, not bothering much about their chicks and nests. This sudden evacuation of the nests by the adults, causes a panic among chicks and fledglings. Their fear is reflected through their struggle by sudden hopping and beating of their tiny wings, which enable them to escape to safety to some other area. As a result of which accidents occur and a few chicks do fall to the ground to die. But, most of the nestlings which have not developed enough strength to stand up or beat wings lie helpless in the nest. In Sajnakhali bird sanctuary, I have observed that the birds are so sensitive that they become alarmed even when a country boat is traversing a creek through or near the sanctuary.

FOOD OF CHICKS AND FLEDGLINGS

Mukherjee (1975) gave a detailed analysis of the food of the Openbill in Sundarban and found that 85 per cent of its food comprised of Mollusca in wet season. Both parents gather soft body and viscera of the gastropods, which are skillfully extracted from shells chiefly of *Pila globosa*, to feed the young. Availability of gastropods does not pose a problem since the area is well-watered. These are collected from wet paddy fields and marshes. The bird flies to the nests to regurgitate the food on the floor of the nest for the brood. The supply of food is about 5-6 times in a day. Chicks and fledglings pick up the food-material from the floor.

BREEDING SUCCESS

Breeding success was about 50 per cent, based on the remaining fledglings almost ready to fly. This was observed in ten nests in Sundarban which had a total of 41 eggs and the count of fledglings in advanced age was 20 only. It takes 35-36 days for the fledglings to fly after hatching and they finally leave the nest after 6 weeks.

POPULATION

In approximately one hectare of intensive nesting area in Sajnakhali, Sundarban, the total number of nests of Openbill counted was approximately 80 in the year 1977 (Plate). The population of adult birds together with the fledglings at the closure of the breeding season in that area was 320. In about 350 hectares of the total breeding area, the estimated population was over 10,000 birds.

ZOOLOGY DEPARTMENT,
CALCUTTA UNIVERSITY,
CALCUTTA-700 019,
April 6, 1978.

ANAND MUKHOPADHYAY

REFERENCE

MUKHERJEE, A. K. (1975): Food-habits of Water-birds of the Sundarban, 24-Parganas District, West Bengal, India. *J. Bombay nat. Hist. Soc.* 71: 188-191.

9. THE NESTING OF THE COOT (*FULICA ATRA*) IN THE VILLAGE POND OF KHANDALA

Lavkumar Khachar's note, in the *Journal* vol. *74*: 525, recording several Coots (*Fulica atra*) nesting near Nasik, reminds me that last month (December 1978) Fr. J. Hernandes of our Institute reported a pair nesting in the village pond along the roadside at Khandala (Poona). There are earlier records of Coots nesting near Poona, where Major Betham (*JBNHS* 14 p. 176) found it breeding between 14th July and 17th August 1901. He specifically refers to this being the first occasion on which he found the species nesting, in India. Some of these eggs are in the BNHS collection which, contains another obtained at Pashan, near Poona, on 29th August 1920 by F. Ludlow.

Sálim Ali and Humayun Abdulali in "The Birds of Bombay and Salsette" (1939) said that there were no nesting records from Bombay, but I later discovered in the St. Xavier High School collection, an egg taken at Mahalaxmi, Bombay in 1910. It would appear that the nesting of this species in peninsular India is sporadic.

Incidentally, INDIAN HANDBOOK (*2*:181) refers to Whistler's statement (Pg. 263, The Avifaunal Survey of Ceylon - 1944).

"It has now established in Ceylon" (Giant's Tank, near Marungam), but adds on page 183. "It has not yet been recorded nesting in Ceylon". It may be worthwhile drawing attention to a note by A. E. Butler in *Ceylon Bird Club notes*—December 1962, where he refers to a young Coot brought to him on 5th December in brownish-black plumage, with the shield undeveloped, and the bill pinkish in colour. There would appear to be no doubt that Whistler meant that he had nesting records for Ceylon (Sri Lanka).

ST. XAVIER'S HIGH SCHOOL,
BOMBAY-400 001,
February 6, 1979.

A. NAVARRO

10. A NOTE ON THE SURVEY OF THE GREAT INDIAN BUSTARD (*CHORIOTIS NIGRICEPS*)

Shri R. S. Dharmakumarsinhji, Regional Honorary Secretary (West) of the Indian Board for Wildlife, Member of the Maharashtra State Wildlife Advisory Board, and Member of the Working Group of World Bustards, was keen that we should survey the habitat of the Great Indian Bustard (*Choriotis nigriceps*) in Marathwada region, with a view to afford stricter protection to this rare bird, which is alarmingly on the decline and to promote conditions for its breeding and multiplication. The likely habitat of this bird, was indicated as the area in the vicinity of the confluence of the rivers Godavari and Pravara, known as the Pravarasangam, about 40 km to the southwest of Aurangabad district, on its border with the adjoining Ahmednagar district. Another probable site suggested, was the area near about the confluence of the rivers Godavari and Purna, about 20 km to the south of Purna in Parbhani district. The Divisional Forest Officers concerned, as also the field-staff, were given description the bird and were asked to keep an eye on its occurrence and movement and to report no sooner than it was sighted.

Local enquiry revealed that nearly two decades ago this bird was seen in fair numbers, in the grassland interpersed with cultivation between Vaijapur and Gangapur, along the river Godavari on the south-western border of Aurangabad district. The other likely areas indicated were: Shiur 50 km to the north-west of Aurangabad on the Malegaon road, Nimgaon-Chaoba in the eastern part of Ashti taluka, in Beed district, bordering Ahmednagar district, Chausala, 35 km to the south of Beed in Beed district, and near about Ruibhar and Tuljapur in Osmanabad district.

We had been in quest for the bird for nearly a year when on 28-9-1978 accompanied by Shri K. K. Chavan, Divisional Forest Officer, Aurangabad. I undertook a rapid survey, of the tract between Vaijapur and Gangapur along the river Godavari. After a brief halt at Gangapur, we proceeded southwards to Pravarasangam (the confluence of rivers Godavari and Pravara) and crossed over into Newasa taluka, of Ahmednagar district, to the other bank of the river Godavari. Enquiry about the bird, with the local villagers near Pravarasangam, drew a blank. We found there was no access by road, along the river Godavari on the other side of the Pravarasangam. We therefore thought of returning and surveying the fringe, on the other side of river Godavari in Aurangabad district. As we were proceeding along this course, we met some villagers near Pravarasangam, who were hacking, *Prosopis juliflora* (Mesquite), which has wildly overrun the low-lying tract, near the confluence of the above rivers for fuelwood. Enquiry with them, gave us a ray of hope, as one of them said, that he had seen this bird two years ago, in bajra fields near his hamlet, at Babulkheda, in Newasa taluka, in Ahmednagar district. He described the bird, vividly and offered to take us to the site.

It was incredible, that almost on our arrival I could sight two bustards foraging for food, on the edge of a bajra field about a hectare in extent. On two sides of the field, were small patches of grassland, admeasuring barely 2 ha. dotted with shrubby growth of ber (*Zizyphus jujuba*) and hivar (*Acacia leucophloea*). The birds were about 150 m away from us. We tried to approach them on foot, to have a closer glimpse and we succeeded in getting within a distance of about 30 m from them. The birds which had strayed into the bajra field perfectly camouflaged with the crop. We could spot another pair, in all four birds. Two were smaller than the others, leading to infer, they were a pair each, male and female. As we got closer to them we could clearly see their majestic, almost martial stride, with their conspicuous black-crested crowns, swivelling right and left, looking out warily for the intruder. As we got closer to them, within a range of about 30 m they took off in the air, almost instinctively, flapping their wings rhythmically.

Though the common vernacular name of the bird is 'maldhok", it is locally known as: "kaldhok" or "kuldhokmane". The villagers informed us, that Babulkheda fields and grasslands are permanent habitat of the birds and that they are also come across in the neighbouring villages of Salbatpur, and Jalka. They estimate a population of about ten birds in this tract.

The natural habitat of the bird, is very much disturbed with cultivation perniciously making inroads into grasslands and the shrubby vegetal growth being cleared in the process. Continual human traffic too, as a result of the spread of cultivation all round, also comes in the way of safe and sheltered habitat for the birds. The fringe of grassland interspersed with cultivation and shrubby growth, on either side of the river Godavari between Vaijapur and Salbatpur (about 1500 sq. km.) both in Aurangabad and Ahmednagar districts, could be considered for protection and development, as available habitat for the vanishing Great Indian Bustard in Maharashtra.

L. H. A. REGO

CONSERVATOR OF FORESTS,
AURANGABAD CIRCLE,
AURANGABAD, (M.S.),
November 27, 1978.

11. ON THE TAXONOMIC VALIDITY OF THE SOUTH INDIAN BLACKHEADED ORIOLE, *ORIOLUS XANTHORNUS MADERASPATANUS* FRANKLIN (AVES: ORIOLIDAE)

(*With a ttxt-figure*)

During the course of a faunistic survey in Andhra Pradesh in 1978, I collected a female specimen of *Oriolus xanthornus maderaspatanus* Franklin on 22 February from Kotapalli, *c* 48 km north-east of Mancherial, Adilabad district, Andhra Pradesh. Its measurements are: Wing 144, tail 87, and bill 30 mm.

The south Indian population of the Blackheaded Oriole was separated from *Oriolus xanthornus xanthornus* Linnaeus, 1758, as *Oriolus xanthornus maderaspatanus* by Franklin, 1831, on the basis of yellow markings on inner secondaries and tertiaries being reduced to terminal spots. Baker (1926) considers the whole population of Indian Blackheaded Oriole under one subspecies, *Oriolus xanthornus xanthornus*. Biswas (1947) also treated *maderaspatanus* as a synonym of *xanthornus*, since he found that the yellow markings are very variable and not a constant character. Rand & Fleming (1957) while studying the birds from Nepal, commented that the

TABLE 1

Assam	6	7	8
5 ♂	20.00–22.00	20.00–23.00	19.00–24.00
	(21.00)	(21.40)	(20.80)
Tripura			
1 ♂	26.00	26.00	25.00
West Bengal			
6 ♂	19.00–26.00	20.00–28.00	20.00–32.00
	(23.00)	(23.50)	(23.00)
1 ♀	19.00	18.00	20.00
1 ?	21.00	24.00	25.00
Bihar			
4 ♂	16.00–24.00	18.00–24.00	16.00–23.00
	(19.00)	(21.50)	(20.25)
1 ♀	27.00	23.00	22.00
2 ?	21.00–23.00	18.00–22.00	18.00–23.00
	(22.00)	(20.00)	(20.50)
Uttar Pradesh			
2 ♂	19.00-23.00	23.00–25.00	25.00
	(21.00)	(24.00)	(25.00)
1 ?	29.00	29.00	31.00
Orissa			
6 ♂	15.00–22.00	12.00–20.00	9.00–17.00
	(18.00)	(16.00)	(14.00)
5 ♀	15.00–27.00	15.00–27.00	15.00–24.00
	(22.00)	(22.00)	(20.00)
Madhya Pradesh			
4 ♂	11.00–17.00	12.00–17.00	11.00–16.00
	(14.50)	(14.25)	(12.50)
Andhra Pradesh			
1 ♂	11.00	11.00	12.00
Maharashtra			
7 ♂	9.00–11.00	10.00–14.00	10.00–15.00
	(7.00)	(11.14)	(11.85)
Goa			
1 ♂	11.00	10.00	10.00
Tamil Nadu			
1 ♀	9.00	9.00	7.00
2 ?	8.00–10.00	8.00–10.00	7.00–10.00
	(9.00)	(9.00)	(8.50)
Kerala			
2 ♂	10.00–11.00	10.00–11.00	9.00–11.00
	(10.50)	(10.50)	(10.00)
1 ?	10.00	10.00	10.00

validity of *maderaspatanus* of peninsular India was questionable. Ali & Ripley (1972, p. 110, note) while admitting *maderaspatanus* stand that the 'subspecies is considered questionable by some authors'.

An attempt has, therefore, been made to review the taxonomic status of *Oriolus xanthornus maderaspatanus* on the basis of the material present at the Zoological Survey of India. The differences of measurements (in mm) of yellow spots on secondaries 6, 7 and 8 (from outside) between the populations from northern and southern India are given in Table 1 (averages in parenthesis).

From the table 1 the difference in the sizes of the yellow spots on three secondaries between the northern and southern populations appears quite clear, although a very small number of specimens exhibit some variations which may possibly be only individual variations. The accompanying sketch showing yellow spots on the secondaries of the two populations also make the issue quite clear (fig. 1).

On the basis of the data presented above, I believe (Ali and Ripley 1972) are justified in recognizing *maderaspatanus* as a distinct subspecies.

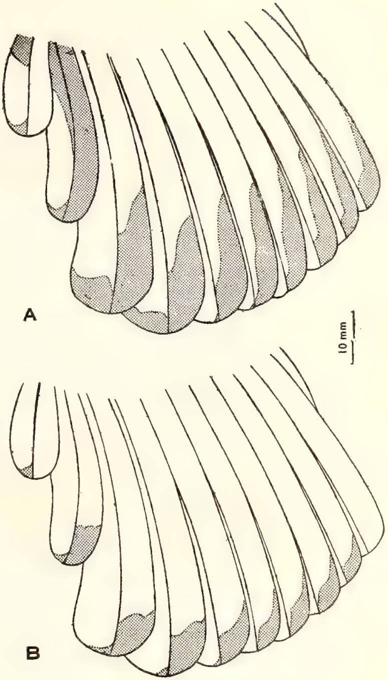


Fig. 1. Secondary wing feathers of *Oriolus xanthornus* showing the extent of yellow spots on the 6th, 7th and 8th feathers.
A. North Indian population; B. South Indian population.

ACKNOWLEDGEMENT

I am grateful to Dr. B. Biswas, Zoological Survey of India, Calcutta, for his valuable suggestions and for going through the manuscript.

N. MAJUMDAR

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January 7, 1978.

REFERENCES

ALI, S. & RIPLEY, S. D. (1972): Handbook of the birds of India and Pakistan, Vol. 5: 110.

BAKER, E. C. S. (1926): Fauna of British India, Birds *3*: 11. Taylor & Francis, London.

BISWAS, B. (1947): Notes on a Collection of Birds from the Darrang District, Assam. *Rec. Indian Mus. 45*: 233.

RAND, A. L. & FLEMING, R. L. (1957): Birds from Nepal. *Fieldiana,* Zoology, *41*(1): 108.

12. ON THE VALIDITY OF *DENDROCITTA FORMOSAE SARKARI* KINNEAR & WHISTLER

In the course of the Vernay Scientific Survery of the Eastern Ghats held during 1929-30, seven specimens of the Himalayan Tree Pie (*Dendrocitta formosae*) were obtained in the Vizagapatam Hills and separated as *Dendrocitta formosae sarkari* by Kinnear & Whistler (1930, Bull. Brit. Orn. Cl. 51 p. 17).

It was referred to again in the course of the Eastern Ghats Report (*JBNHS* 35 p. 517) as differing from the form in the Eastern Himalayas (now *D. f. himalayensis* Blyth).

Biswas 1964, *JBNHS* 60: 650-1 measured three paratypes of *sarkari* (2 ♂♂ 1 ♀) and compared them with a large series (30 ♂♂ 20 ♀♀ 32 o?) from Eastern (*himalayensis* Blyth) and Western (*occidentalis* Ticehurst) Himalayas. Noting the slight overlap in the measurements he expressed the opinion that *sarkari* was synonymous with *himalayensis*. This has been accepted in IND. HANDBOOK (5: 226).

In the course of cataloguing the Bombay Natural History Society collection, I have examined 9 specimens, 2 from the original series from Anantagiri, Vizagapatam Hills, and 7 fresh specimens collected by Sálim Ali at Berbera, Puri, and Mahendragiri, all in Orissa.

While the average measurements are not very different, in series they are strikingly smaller than both *occidentalis* and *himalayensis*, and the range of measurements is also very different.

The wing and tail measurements decline from the north-west (*occidentalis*) through Eastern Himalayas (*himalayensis*) to Orissa and the Vizagapatam Hills (*sarkari*). The measurements overlap with those of the adjoining race, the only consistent difference being the acquirement of a larger wing and tail, both by *occidentalis*, as compared to *himalayensis*, and the latter as compared with *sarkari*.

In the first two, the distribution is contiguous and they no doubt form a cline. The southern birds are, however, isolated and of those examined, the largest wing is 143 mm., bill 23.7 and tail 207.

It is generally overlooked that the bird was described only for its smaller bill. When viewed sideways, it is much smaller than in any of the others and the width at the nostrils never exceeds 11 mm., while it is always more in the others.

On these differences, I think that *sarkari* is a good race and deserves to be retained.

	Wing	Bill	From nostril	Width at nostril	Tail
♂♂					
sarkari	(4) 135-143	28.5-30.6	21-23	9.8-10.6	200, 207
himalayensis	(8) 135-148	29.8-33.3	22-25	11-12	188-224
Biswas's „	(30) 137-151 (142.7)	34-39.5 (36.5)	—	—	194-228
occidentalis	(6) 140-154	32-35	24.3-26	11.3-12.3	233-249
Biswas's „	(4) 147-156	35-37.5 (36.5)	—	—	243-260
♀♀					
sarkari	(5) 133-140	27.5-30.7	21.7-23.7	10-11	193-203
himalayensis	(12) 135-150	29-33.2	22-25	11-12.3	188-233
Biswas's „	(20) 137-148	33.5-39 (36.1)	—	—	192-230
occidentalis	(2) 152, 153	30, 33	22.2, 25.8	11.5, 12.3	238, 243
Biswas's „	(7) 149-156	35-40 (37.4)	—	—	241-261

75 ABDUL REHMAN STREET,
BOMBAY-400 003,
March 31, 1979.

HUMAYUN ABDULALI

13. ON THE OCCURRENCE OF TYTLER'S LEAF WARBLER, *PHYLLOSCOPUS TYTLERI* BROOKS IN GOA

Grubh & Ali (1976) state that they obtained a specimen of Tytler's Leaf Warbler *Phylloscopus tytleri* Brooks in Goa in early December 1972. I have examined this specimen in the collection of the Bombay Natural History Society. The diagnostic characters of this species are its "peculiarly long thin bill" (Ticehurst 1938) and dark lower mandible. Comparison with specimens obtained during the breeding season from Kashmir shows that this specimen does not have these characters. It is clearly a Greenish Warbler, *Phylloscopus trochiloides* (Sundevall), of which I have made a special study (MS.).

Presumably the mis-identification was made on the basis of no wing bar. However, individual Greenish Warblers in worn plumage (as this specimen is) often show very faint or missing wing bars (pers. obs.). The Greenish Warbler goes through its complete annual moult in Spring (Ticehurst 1938) and would be expected to be in worn plumage at this time. Tytler's Leaf Warbler, on the other hand, goes through a complete post-nuptial moult (Ticehurst 1938) and would be expected to be in relatively fresh plumage.

There are therefore only three confirmed records of the Tytler's Leaf Warbler in Winter (Grubh & Ali 1976) and several sight records (Ali & Ripley 1973), all from the west side of the Indian peninsular. The Winter range of this species remains unclear. Ripley records this species in the Dhenkanal District, Orissa, which extends its known winter range considerably further east (Ripley 1978).

I thank Dr. Robert Grubh for help with the Society's collections.

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January 3, 1979.

TREVOR D. PRICE

REFERENCES

ALI, S. & RIPLEY, S. D. (1973): Handbook of the Birds of India and Pakistan. Volume 8. Oxford University Press.

GRUBH, R. B. & ALI, S. (1976): Birds of Goa. *J. Bombay nat. Hist. Soc.* 73: 42-53.

PRICE, T. D. (1978): The Ecology of the Greenish Warbler, *Phylloscopus trochiloides* (Sundevall) in its Winter quarters. Manuscript.

RIPLEY, S. D. (1978): Changes in the bird fauna of a forest area; Simlipal Hills, Mayurbhanj District, and Dhenkanal District, Orissa. *J. Bombay nat. Hist. Soc.* 75(3): 570-574.

TICEHURST, C. B. (1938): A Systematic Review of the Genus *Phylloscopus*. British Museum (Natural History).

14. GREEN MUNIA (*ESTRILDA FORMOSA*) AT DELHI, AND OTHER INTERESTING RECORDS FOR 1978

During 1978 we recorded two species which, according to Ganguli (1975), have not been recorded previously within the Union Territory of Delhi, the Plaintive Cuckoo and the Green Munia, the latter record falling well outside the normal range of the species. In addition we obtained evidence of breeding for two species formerly of doubtful status within the area, the Red and Spotted Munias. All observations were made in the Government Nursery, Sunder Nagar, just beside Delhi Zoo.

Plaintive Cuckoo *Cacomantis merulinus*. An immature of this species was seen on 20 August 1978 perched in the crown of a mango tree, into which it made periodic sallies to snatch insects. It was identified from the similar Bay-banded Cuckoo *C. sonneratii* by the presence of a rufous suffusion on the face and throat, and by the fact that the legs were orange and the bill brown, becoming yellowish at the base of the lower mandible.

Green Munia *Estrilda formosa*. A male was seen feeding in tall grass along with Red Munias on 11 October 1978. The bird was in very fresh plumage and we were able to observe it at ranges down to 3 m. It took no notice of us, but appeared unsettled, flying round more than the other munias present, and after half an hour flew off and did not re-appear. The bird was also seen by Narender Sharma.

According to Ali and Ripley (1974) the species' main range is in central India, but there are two isolated records from the northern part of the sub-continent, at Lucknow and Lahore, and it is therefore possible that a scattered population does exist north of the Vindhyas.

Red Munia *Estrilda amandava*. Birds were seen collecting and transporting nest material on 17 September and 11 October 1978 and pairs were seen with fledglings from 31 October onwards. Spotted Munia *Lonchura punctulata*. One was seen repeatedly carrying strips of green grass blades to a nest in the crown of a palm tree, about 6 m up. The pieces were frequently several times the length of the bird and could be carried only with difficulty. Juveniles were noted in November, but the nest seen being built did not fledge any young.

One other record for 1978 which is worth mentioning is that of a male Dark Grey Bushchat *Saxicola ferrea* seen by AJG on 29 October. The two records mentioned by Ganguli from Delhi were apparently not certain.

c/o Oxford University Press,
2/11 Ansari Road,
Darya Ganj,
Delhi 110 002,
February 19, 1979.

A. J. GASTON
J. MACKRELL

REFERENCES

Ali, S. & Ripley, S. D. (1974): Handbook of the Birds of India and Pakistan, Vol. 10. Oxford University Press, Bombay.

Ganguli, U. (1975): A Guide to the Birds of the Delhi Area. I.C.A.R., New Delhi.

15. A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY PARTS 1-17—NON-PASSERIFORMES

ERRATA

JBNHS Vol. p.	Serial page No.	I. H.* No.	
65(1):189	(8)	23	"December" is month of acquisition, and not collection.
65(1):191	(10)	33	For *"Ardea imperialis"* read *"Ardea insignis* Hume".
65(2):423	(24)	97	For "25356" read "15356".
65(2):424	(25)	101	Specimen 15384 marked "Gadwall/Mallard hybrid" has been re-identified as a teal/Baikal teal hybrid, Bull. BOC 1969:100.
65(2):429	(30)	121	The specimen marked "Gangpur, Bihar" was obtained by the ruler of that State on Ib River, Sambalpur, Orissa.
65(3):700	(36)	138	"Bhagat State (in Simla Hills), N.W.P." *not* N.W.F.P."
65(3):706	(42)	157	Khojdar is not in Persia but in Baluchistan 27.48N., 65.36E (Dr. R. D. Etchecopar, *in epist.*).
65(3):713	(49)	185	In line 8 for *"bengalensis"* read *"indicus"*.
65(3):718	(54)	203	For "Shaiba, Arabia" read "Shaiba, Iraq".
66(2):264	(73)	264	For "Manipur Bush Quail" read "Assam Bush Quail".
66(2):267	(76)	278	For "Bharatpur, Rajasthan" read "Karauli, District Sawai Madhopur, Rajasthan". (Sent by Maharaja of Bharatpur!).
66(2):270	(79)	286	For *"Tragopan satyr"* read *"Tragopan satyra"*.
66(2):283	(92)	314	Insert name "Yellowlegged Button Quail".

*Originally based on Ripley's Synopsis.

66(3):544	(97)	334	For “Shaiba, Arabia” read “Shaiba, Iraq”.
66(3):547	(100)	347	For “Shaiba, Arabia” read “Shaiba, Iraq”.
66(3):559	(112)	384a	This is synonymous with No. 375 and should be entirely omitted.
67(2):282	(122)	415	The measurements of Sp. No. 14793 from Chilka Lake are erroneous and the specimen is *minutus* No. 416. In the penultimate sentence the word “omitted” is in error for “accepted”.
67(2):283	(123)	420	Delete “nil” for some specimens under the next may be of this subspecies.
67(2):284	(124)	424	Delete “nil” for some specimens under the next may be of this subspecies.
67(2):289	(129)	439	For “Shaiba, Arabia” read “Shaiba, Iraq”.
68(1):148	(160)	535	In first line read “........ there is only *one* female ....”.
68(1):152	(164)	544a	Ten live birds in Calcutta Zoo (1 April 1973) had yellow claws.
68(3):771	(191)	605	Under subadult tarsus read “av. 40.4”.
69(1):104	(195)	614	In line 5 for “third primary” read “first primary” and in following paragraph the date of the Ratnagiri specimen should be “8 January 1879”.
69(1):105	(196)	617	After “Supa” add “N. Kanara”.
69(1):106	(197)	618a	The single specimen is *Otus magicus* (?)
69(1):115	(206)	643	For “Sonapura” read “Sonarupa”.
69(1):121	(212)	660b	2 ♂♂ from Nilgiris (February 1975) agree with the bird from Yercaud and the differences from *Strix leptogrammica indranee* Sykes are probably due to the other skins being older and having faded.
69(1):126	(217)	675	In type locality for “Bengal” read “now Chaibassa, Bihar”.
69(1):129	(220)	682a	In last line after “*JBNHS*” insert ‘69: 185”.
69(2):382	(225)	698	For “*Apus acuticaudis*” read “*Apus acuticauda*”. (R. K. Brooke, *Bull. B.O.C.* 1969:97-99).
69(2):385	(228)	707	For “*C. p. batasiensis*” read “*C. p. balasiensis*”. (Wells & Medway, *JBNHS* 723:539-542).
69(3):541	(236)	726	Insert locality “Jalawli, collected by T. R. Bell = N Kanara?”.

ADDENDA

Only species/subspecies of which no specimens were available or had not been correctly identified are now listed.

Indian Handbook No.

19 *Phaeton lepturus lepturus* Daudin (Mauritius)
1 off Battye Malve, between Andaman and Nicobar Islands (pair of central feathers only).

43 *Ardeola bacchus* Bonaparte (Malay Peninsula), 1 ♂ Sipighat, South Andamans, 1 ♀ Narcondam Island.

108/9 Paget's Pochard, a cross between *Aythya ferina* and *Aythya nyroca* netted at Bharatpur. *JBNHS* 69(2): 415-417.

128 *Aviceda leuphotes andamanensis* Abdulali & Grubh
1 ♂ 1 ♀ Type & paratype (Wrightmyo, South Andaman).

202 *Spilornis cheela klossi* Richmond (Pulo Kunyi, Great Nicobar).
1 ♀ Campbell Bay, Great Nicobar, (Topotype).

240 *Francolinus pictus pallidus* (J. E. Gray) (Udaipur).
1 ♂ Udaipur, 1 September 1977—See note *JBNHS* 76(2): 362.

— *Lophurus* sp.
In *JBNHS* 66(2), p. 276, I referred to 3 specimens (2 ♂ 1 ♀) from near Htangaw between Kachin Hills and China which I was unable to identify. A ♂ and ♀ were sent to Dr. Delacour at American Museum of Natural History and in a letter dated 4 November 1974 he replied "They are *L. leucomelanus lathami* (Horsfield's Kalij) *williamsi*, but they are much nearer to *lathami*. There are a lot of more or less intermediate specimens from the Kachin Hills. They are unstable and do not deserve names".

254 *Coturnix chinensis trinkutensis* (Richmond) (Trinkut Island, Nicobar Group).
2 ♂♂ 2 ♀♀ Trinkut Island, Central Nicobars (Topotypes).

345b *Amaurornis phoenicurus midnicobarica* Abdulali (Nancowry, Central Nicobars).
1 ♂ (Holotype) 1 ♀ Nancowry; 1 ♂ 1 ♀ Camorta.

378 *Charadrius hiaticula tundrae* (Lowe) (Valley of Yenessei)
1 o? Muthupet, Thanjavur dist., Tamil Nadu.

386 *Numenius phaeopus variegatus* (Scopoli) (No locality = Luzon, ex Sonnerat).
2 obtained from Japan in exchange for Indian specimens. Others from Andamans & Nicobars, and 1 from Pulicat, Madras, transferred from 385 (*JBNHS* 71, p. 497).

427 *Phalaropus fulicarius* (Linnaeus) (Hudson Bay)
1 ♂ Oregon, U.S.A. (in exchange).

527b *Macropygia rufipennis tiwari* Abdulali (Campbell Bay, Great Nicobar)
4 ♂ 1 ♀ Campbell Bay, Great Nicobar.

543 *Chalcophaps indica robinsoni* Baker (Cocawath Estate, Ceylon)
♂ No. 23485, collected by S. Green

at Colombo, Ceylon.

610a *Phodilus badius ripleyi* (Hussain & Reza Khan (Nelliampathi Hills)
1 Peria Solai Estate, Nelliampathi, Kerala (Type).

642c *Otus magicus* subsp. yet undescribed.
1 ♂ Campbell Bay, Great Nicobar (1969).

646 *Ninox affinis* ***affinis*** Beavan (Aberdeen Point, Port Blair, Andaman Islands.
1 ♀ South Andamans, (Topotype).

647 *Ninox affinis isolata* Baker (Car Nicobar)
2 ♂ ♀ Car Nicobar*, 1 ♀ Camorta, (* Topotypes).

647a *Ninox affinis rexpimenti* Abdulali (Great Nicobar).
2 ♂♂ 1 ♀ Topotypes.

728 *Ceyx erithacus macrocarus* Oberholser (Great Nicobar)
1 ♂ Campbell Bay, Great Nicobar. The specimen obtained in 1966 and listed under this form is of the nominate race and was wrongly identified.

729 *Pelargopsis amauroptera* (Pearson) (Calcutta)
2 ♂♂ Bhitarkanika, Athadhar Forest Division, Balasore, Orissa.

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75 ABDUL REHMAN STREET,
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June 8, 1977.

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16. TERRITORIALITY IN IMMATURE CAPTIVE SALTWATER CROCODILES (*CROCODYLUS POROSUS* SCHNEIDER)

Since 1975, extensive rearing of saltwater crocodiles, hatched in captivity, has taken place at Dangmal, Orissa as one facet of a conservation programme on this endangered species (FAO, 1975).

Hatchlings show a strong tendency to aggregate, but by about eight months old they start to loose this aggregation tendency becoming progressively more solitary if space permits. In the early spring (February/March) of their third year, at an age of 2½ years, signs of territoriality/dominance behaviour commenced in groups in two successive years (Table 1)). This behaviour was exhibited by both sexes.

The dominant female of the all female batch hatched in 1975, did not allow the other four females to enter the 4×4×1 m deep pool when she was in the pool or to approach her on land. In September 1978 this female was removed and housed separately, following which the next largest female in the group became dominant. The 1976 batch showed similar dominance behaviour from February/March 1978, the dominant in this year being a male. Towards the end of the third year the dominants commenced actual physical attacks on the subordinate members of their respective groups. This behaviour was very marked during the fourth year resulting in injuries to the head, jaws and back legs.

We consider that this dominance behaviour results from territoriality which cannot find expression in a confined space, hence resulting in the development of a dominance hierarchy.

The development of strong territoriality is

TABLE 1

DEVELOPMENT OF TERRITORIALITY/DOMINANCE BEHAVIOR IN GROUPS OF IMMATURE SALTWATER CROCODILES. SIZES (M) AND WEIGHTS (KG)

Date of birth	Time/Age of commencement of territorial/dominance behaviour	Composition of group	Dominant		
			Sex	Size	Weight
21 August 1975	Feb/Mar 1978 (2½ years)	5 Females	Female	1.42	10.5
17 August 1976	Feb/Mar 1979 (2½ years)	3 Females 2 Males	Male	1.29	7.5

surprising in immature individuals assumed to have at least a further 5 - 7 years of immature life prior to first breeding (Yangprapakorn 1971). Furthermore, the existence of strongly developed female territoriality is likewise unexpected. However, as pointed out by Neill (1971) virtually nothing is known of the biology of *C. porosus* outside of nesting. Furthermore, crocodilians may represent a behaviourally more diverse group than hitherto limited data have suggested.

It is standard practice in large-scale crocodilian rearing to restrict the numbers per pool, to keep year classes separately, and to resort individuals within year classes so that similar-sized individuals are kept together. This is done to prevent bullying of smaller individuals by larger animals. However, the behaviour described here for *C. porosus* is markedly different in degree from our experience with other crocodilian species.

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S. K. KAR

REFERENCES

FAO (1975): India: Gharial and Crocodile Conservation Management in Orissa (based on the work of H. R. Bustard) FAO, Rome (FO:IND/71/033).

NEILL, W. T. (1971): The Last of the Ruling Reptiles. Columbia Univ. Press. New York.

YANGPRAPAKORN, U. (1971): Captive Breeding of Crocodiles in Thailand. *In* Crocodiles. IUCN Publs. N.S. Suppl. *33*: 98-101.

17. STATUS OF THE GHARIAL (*GAVIALIS GANGETICUS*) GMELIN) IN BHUTAN

The distribution of the gharial is given by Malcolm Smith (1931) as, "The Indus, Ganges, Mahanadi and Brahmaputra Rivers and their tributaries, and the Kaladan River, Arakan."

The gharial formerly occurred in the Manas River, a tributary of the Brahmaputra which rises in the hill country in the himalayan Kingdom of Bhutan and passes through southern (lowland) Bhutan before entering Assam. In 1978 I carried out crocodile field work in Bhutan including Manas Sanctuary (Bustard 1979) and confirmed the presence of ideal gharial habitat on the Bhutan portion of the Manas river from the border with India until the Manas enters the hill country. This area of the Manas river appeared similar to the so-called Satkosia Gorge of river Mahanadi in Orissa which is one of the sanctuaries declared for the gharial under the Government of India Crocodile Project. Satkosia Gorge has long been famous as gharial habitat. The Manas river within Bhutan includes good basking/nesting sandbanks further enhancing its habitat potential.

No gharial appear to occur today in this stretch of the Manas River in Bhutan nor in the stretch within India adjacent to Bhutan. The last definite records of gharial were of an adult of 5-5.5 m which was frequently seen between 1962 and 1964 about 8 km upstream from the Bhutanese Manas Tourist Lodge, and another individual of about 4.5 m which was seen daily for about 17 years until construction of the Tourist Lodge at the site where the Tourist Lodge now stands.

In November 1977 Forest Department personnel of Project Tiger brought a gharial, reported to be about 1.5 m in length, and liberated it in the Manas river on the Bhutanese side of the Indo-Bhutanese border. This gharial was seen for 7 months until the commencement of the 1978 monsoon. However, I was advised by Shri Deb Roy, I.F.S., Field Director, Project Tiger, Manas, during December 1979 that this gharial is still being seen occasionally.

As recorded in my 1979 FAO report, efforts should be made to re-establish the gharial in Bhutan in this good habitat in Manas, especially in view of the extensive protection now afforded to Manas Sanctuary.

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REFERENCES

BUSTARD, H. R. (1979): Bhutan: Crocodile Conservation Commercial Farming. FO:DP/BHU/78/003. FAO. Rome January 1979.

SMITH, M. A. (1931): The Fauna of British India including Ceylon and Burma. Reptilia and Amphibia. *1*. Loricata Testudines: Taylor and Francis, London.

18. EXTENTION OF RANGE OF THE NARROW-MOUTH FROG, *UPERODON GLOBULOSUM* (GUNTHER) TO KAMRUP DISTRICT, ASSAM

The narrow-mouth frog, *Uperodon globulosum* (Günther), is believed to be a rare species from its small numerical records from the reported areas, although it enjoys a wide range of distribution. The species has been obtained from West Bengal, Bihar, Madhya Pradesh and Maharashtra. Orissa has also been included in the range of distribution of this species (Boulenger 1890) but no specimen from that state could be traced. In West Bengal, this species has been collected from the Botanical Gardens, Shibpur, Howrah District in 1880's; from Khardah, 24 Parganas District in 1928, from Jalpaiguri District in 1956, and recently from Barakpur and Baj Baj, 24 Parganas District.

In their note on its record from Jalpaiguri, West Bengal, Bhaduri and Basu (1956) wrote: "The presence of *U. globulosum* in Jalpaiguri in northern Bengal particularly as it is situated in the borderline of Assam, seems to be an interesting feature. Its occurrence, therefore, in some parts of Assam may not be unlikely from the point of view of its distribution". This remark has now been fully borne out by a recent finding of an example of this species from a termitarium in Mothanguri, Manas Sanctuary, Kamrup District, Assam, by one of us (S.S.S.), who brought a live specimen to Calcutta.

The alleged rarity of the species is probably because it eludes collectors from its subterranean habits. There remains much to be learnt about the biology of this narrow-mouth frog. On earlier occasions the frog was exhumed from termitarium or from fields, usually from among debris. Abdulali & Daniel (1954) found it in fair numbers in the Salsette Island, Bombay, when the frogs came out of their burrow habitats for breeding. The present collection was from a forested area, in the semi-open mixed forest tract of Manas Sanctuary, in a block where the soil was damp and the forest floor was littered with piles of decaying logs, mostly infested with termites. The narrow-mouth frog was located underneath a decaying log and partly embedded in soft clay. The soil termite, *Speculitermes* sp., was found in association with this frog. This termite does not make exposed mounds but forms a system of tunnels in the clay as well as in the decaying logs lying on the ground. The frog was found buried in the soft clay, head and part of its upper back out of soil but under a decaying log, hollowed out just over the frogs body. Termites were apparently undisturbed by the presence of the frog. However, it is presumed that those termites constitute the chief food of the frog. The live specimen was brought back to Calcutta. No attempt was made to feed this animal and it died after 14 days of starvation. It may be recalled in this connection that Mukerji (1933) observed this species died after 31 days of starvation.

Material: 1 ♀, collected on 14 June 1975 by Shri S. S. Saha from Mothanguri, Manas Sanctuary, Kamrup District, Assam, and deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

The present finding, extending the range of distribution of *Uperodon globulosum* (Günther) to Assam, has significant bearing on the zoogeography of the species. Discoveries from further eastern part of its known range, particuluarly from the Indo-Malayan subregion may, perhaps, throw some light on the affinity of the species.

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REFERENCES

ABDULALI, H. AND DANIEL, J. C. (1954): Extention of range of the frog *Uperodon globulosum* Günther). *J. Bombay nat. Hist. Soc. 52*: 637.

BHADURI, J. L. AND BASU, S. L. (1956): Further extention of range of the frog, *Uperodon globulosum* (Günther) in Jalpaiguri, West Bengal. ibid. *53*: 712-713.

BOULENGER, G. A. (1890): Fauna of British India. Reptilia and Batrachia. Taylor and Francis. London.

MUKERJI, D. D. (1933): Some observations on burrowing toad, *Cacopus globulosum* Günther. *J. Proc. Asiat. Soc. Bengal,* N. S. *27*: 97-100.

19. OCCURRENCE OF *BOTIA LOHACHATA* CHAUDHURI IN HIMACHAL PRADESH WITH REMARKS ON THE TAXONOMY OF INDIAN SPECIES OF *BOTIA* GRAY (PISCES: COBITIDAE)

Recently, I came across in the fish collection of this Station 3 specimens of *Botia lohachata* Chaudhuri collected from Nakeri Khud, 10 kms from Dehragopipur, Distt. Kangra (H.P.). These specimens, labelled as *Botia dayi* Hora, agree well with the account of *B. lohachata* as given by Chaudhuri (1912). Since *B. lohachata* is hitherto known from Bihar, Uttar-Pradesh, Rajasthan (Udaipur), Delhi, Punjab and Sind (Menon 1974), the present find extends its distributional range to Himachal Pradesh, as may be expected from the zoogeographical point of view (Menon 1962).

Tilak and Hussain (1977) in their checklist of the fishes of Himachal Pradesh included two species of *Botia, B. birdi* Chaudhuri and *B. dayi* Hora, the latter species recorded for the first time from Himachal Pradesh. Hitherto, *B. dayi* was known from Eastern Himalayas (Menon 1974) and from the western ghats (Rao and Yazdani, 1978).[1]

Day (1878-1889) referred to 6 species of *Botia,* namely, *B. nebulosa* Blyth, *B. dario* (Ham.), *B. geto* (Ham.), *B. almorhae* Gray, *B. berdmorei* Blyth, and *B. histrionica* Blyth, As Day's (op. cit.) key to the species of *Botia,* based mainly on the differences in the finray counts and number of barbels, was not helpful Hora (1922) analysed *Botia* spp. on the basis of other characters such as size and position of eyes and length of snout in relation to head. He (op. cit.) dealt with altogether 17 species, 8 of which, namely, *B. almorhae, B. birdi, B. dario, B. geto, B. histrionica, B. lohachata, B. rostrata,* and *B. striata* were considered valid from India. He (op. cit.) synonymised *B. berdmorei* (having 6 barbels) with *B. hymenophysa* (Bleeker)—a species (having 8 barbels) known from Burma, Thailand, Indo-Australian Archipelago and rejected *B. nebulosa* of Day on the ground that it was a species of *Noemacheilus*.

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[1] See vol. *76* (3): 525-527, for the validity of this record—Eds.

Hora (1932) described *B. dayi* from River Mahanadi, Darjeeling Himalayas and synonymised with it the species described by Day (1878, 1889) under the name *Botia geto*. Menon (1974), in his check-list of fishes of Himalayan and Indo-gangetic plains, recorded 6 species of *Botia*, namely, *almorhae, berdmorei, dario, histrionica, lohachata* and *rostrata*. He (op. cit.) ignored the synonymy of *B. berdmorei* with *B. hymenophysa* but omitted *B. birdi*, perhaps inadvertently, and *B. geto* without clarifying their taxonomic status. Thus, only 8 species of *Botia*, namely, *almorhae, birdi, dario, histrionica, hymenophysa, lohachata, rostrata* and *striata* may be provisionally recognised in India.

As Menon (op. cit.), in his check-list, includes *Botia berdmorei* from India, and as Hora synonymised it with *B. hymenophysa*, Hora's (1922) key may be modified as follows:

Under Group II. Barbels eight (*Botia* s.s.), after the position B, I, b, i and after the statement "Anterior origin of dorsal almost equidistant from tip of snout and base of caudal", add

Length of head greater than depth of body . . . . . .*Botia hymenophysa*

Length of head almost same as depth of body . . . .

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ZOOLOGICAL SURVEY OF INDIA,
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REFERENCES

CHAUDHURI, B. L. (1912): Descriptions of some new species of freshwater fishes from North India. *Rec. Indian Mus.*, Calcutta, *7*, pp. 437-444.

DAY, F. (1878): The fishes of India, being a Natural History of the fishes known to inhabit the seas and freshwater of India, Burma, and Ceylon (Reprinted in 1958 William Dawson & Co., London). pp. 1-XX-778, pls. 195.

———— (1889): The Fauna of British India, including Ceylon and Burma, Fishes, London, *1*, pp. 1-XIII, 1-548, 104 figs.

HORA, S. L. (1922): Notes on fishes in the Indian Museum. IV. On fishes belonging to the genus *Botia*, (Cobitidae). *Rec. Indian Mus.*, Calcutta, *24*(3): 313-321.

———— (1932): Notes on the fishes of the Indian Museum XIX. On a new loach of the genus *Botia*, with a remark on *B. dario* (Ham.-Buch.). *Rec. Indian Mus.*, Calcutta. *34*: 571-573.

MENON, A. G. K. (1962): A distributional list of fishes of the Himalayas. *J. zool. Soc. India*, Calcutta, *14*(1): 23-32.

———— (1974): A check-list of fishes of the Himalayan and the Indo-gangetic plains. *Inland fisheries Society of India, Special Publication* No. *1*, pp. i-vii, 1-136.

RAO, M. B. AND YAZDANI, G. M. (1978): Occurrence of the cobitid genus *Botia* Gray in the western ghats of India. *J. Bombay nat. Hist. Soc. 74*(2): 367-368.

TILAK, R. AND HUSSAIN, A. (1977): A check-list of the fishes of Himachal Pradesh. *Zool. J. Syst. Ed.*, *104*: 265-301.

20. THE GIANT MAHSEERS OF KUMAUN HIMALAYAS WITH A RECENT RARE RECORD

The mahseers of Kumaun Himalayas, either from lentic or lotic waters, are famous throughout the world. They not only provide good sport for the angler but are also good to eat. Records of the largest mahseers caught in Kumaun and other waters of the Himalayas are many in the past, but few recent records are available.

Hamilton (1822) found a 271 cm (9 ft) mahseer in his collctions from India; Thomas (1893) reported 18 to 25 kg mahseers as common in India without any reference to Kumaun Himalayas; Corbett [1923, 1937, in his observations sent to B. S. Raj (1945) in mahseer symposium] records mahseers of approximately 27.00 kg from Malwa tal, a 22.50 kg from Naini tal and one of 13.50 kg from Bhim tal. Hora (1939, 1940, 1951) made observations on the natural history and identification of different mahseer species, with the largest size upto 60 cm (2 ft) from his all-India collections. Raj (1945) reported that Mr. Langdale Smith reared a 13.50 kg mahseer in his pond at Bhowali near Naini tal. McDonald (1939) reported his largest mahseer of 12.75 kg from Himalayan rivers. The size and population of mahseers of Kumaun have been going down in recent years, and no recent record of giant mahseer is available. However, I was able to record the largest recent catch of an 18.50 kg female mahseer (*Tor putitora*) by rod and line in the early morning (at 6.10 a.m. on 8th August, 1977) from Bhimtal lake of Kumaun Himalayas. The bait used was a 0.2 kg Jabua (*Barilius bendelisis*). This mahseer was caught in the inshore region from the lake bank in breeding season when the fish migrates to shallow spawning sites in Bhimtal lake. They also come inshore to feed even in spawning season (Pathani 1979). Thus the large female mahseer may have come to the shallow region for spawning and littoral feeding and was caught by rod and line at dawn.

The fish exhibited swollen abdomen and female secondary sexual characters (as already recorded by Pathani 1978). The various body measurements taken are as follows:

Total length, 126.00 cm; caudal fork length, 117.00 cm; standard length, 110.00 cm; body length, 78.30 cm; head length, 31.70 cm; eye diameter, 3.10 cm; body depth, 31.00 cm; depth at caudal region, 11.00 cm; length of dorsal spine, 16.00 cm; length of pectoral fins, 16.00 cm; length of pelvic fins, 14.00 cm; length of anal fin, 9.40 cm; and length of caudal fin, 16.00 cm.

The weight of the fish with viscera was 18.50 kg. The age of the fish determined by me by scale method was 12 ± years.

Autopsy of the fish was done and length and weight of ripe ovary was recorded, its total length being 35.5 cm and weight being 1.5 kg. The ovarian eggs were interspersed in four sizes confirming the observations of Pathani (1979). The largest mature egg diameter ranged from 3.0 to 3.2 mm and the smallest egg diameter ranged from 0.66 to 0.74 mm. The total fecundity estimated was 3,56,500. The length of alimentary tract was 246 cm and length of intestinal bulb was 40 cm.

The present rare record of an 18.50 kg. mahseer is the first such record in the last four decades, and is higher than the last record of 13.50 kg from Bhimtal by Jim Corbett. The present find also demonstrates the rarity of giant sized mahseers in Kumaun waters.

I am grateful to Dr. S. M. Das for critically going through the manuscript. Thanks are also due to CSIR, New Delhi for awarding a fellowship.

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REFERENCES

DAS, S. M. AND PATHANI, S. S. (1978): Studies on biology of Kumaun mahaseer *Tor putitora* (Ham.). *Indian J. Anim. Sci. 48*(6): 461-465.

*HAMILTON, B. (1822): An account of the fishes in river Ganges and its branches. Edinburgh, p. 405.

HORA, S. L. (1939): Game fishes of India VIII, (The putitor mahseer). *J. Bombay nat. Hist. Soc. 40*: 272-285.

——————— (1940): The game fishes of India, IX. The tor mahseer, *Tor tor* (Hamilton), ibid. *40*: 518-525.

*——————— (1951): Knowledge of ancient Hindus concerning fish and fisheries of India. 2. Fish in the Sutras and Smruti literature. *Jour. Asiastic Soc. Dett. 17*: 61-68.

PATHANI, S. S. (1978): A note on secondary sexual characters in Kumaun mahaseer, *Tor tor* and *Tor putitora* (Ham.). *Indian J. Anim. Sci. 48*(10): 773-775.

——————— (1979): Studies on the ecology and biology of Kumaun mahaseer, *Tor tor* and *Tor putitora* (Ham.). *Ph. D. Thesis,* Kumaun University, Naini Tal.

RAJ, B. S. (1945): The decline of mahseer fisheries of the Kumaun lakes and possible remedy. *Proc. Nat. Inst. Sci. India, 11*(3): 341-345.

SINGH, A. *et al.* (1975): Souvenir of the Corbett Centenary year, 70 p.

THOMAS, H. S. (1893): The Rod in India. W. Thacker & Co., London.

*Original not consulted.

21. MALE IN COPULATION WITH DEAD FEMALE OF *HIEROGLYPHUS NIGROREPLETUS* BOL.

Uvarov (1928) described abnormal pairing among locusts. He mentioned that many males copulate with dead females. Husain and Mathur (1945) stated that pairing of male with dead female locust is a physical impossibility. Bhatia (1959) observed eight instances of mature males of Desert Locust, *Schistocerca gregaria* Forsk. copulating with females which had died the previous night. Katiyar (1962) observed males of *Aularches punctatus* Drury and *Parahieroglyphus bilineatus* Bol., to ride and copulate with dead females. He also observed a few females of *P. bilineatus* in coitus with dead males.

During the normal course of breeding of *Hieroglyphus nigrorepletus* Bol. males were noticed to continue copulation even after the death of female. This appears to be the first report of such phenomenon in *H. nigrorepletus*.

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REFERENCES

BHATIA, D. R. (1959): Copulation of Locusts males with dead-females. *Indian J. Ent.*, New Delhi, *21*(3): 220.

HUSAIN, M. A. AND MATHUR, C. B. (1945): Studies on *Schistocerca gregaria* Forsk. XIII. Sexual life. *Indian J. Ent.*, *7*(1 & 2): 89-101.

KATIYAR, K. N. (1962): A crazy-instinct of copulation in males with dead females and vice-versa among short-horned grasshoppers (Acrididae: Insecta). *Sonderdruck Aus Z. Ang. Entomologie*, *49*(4): 399-401.

UVAROV, B. P. (1928): Locusts and Grasshoppers. London (Imp. Inst. Ent.). A text Book on Locust and Grasshoppers.

22. MATERNAL CARE IN *OXYRHACHIS TARANDUS* FABR. (MEMBRACIDAE: HOMOPTERA)

Oxyrhachis tarandus is a common species of membracid usually found on *Acacia arabica* and *Cassia fistula*. It is a brown insect with the posterior pronotal process extending backwards upto the posterior end of the aband fulgorids. The female of this species anterolateral processes of the pronotum are in the form of short tricarinate horns.

This treehopper caught our attention during field surveys for collecting the membracids and fulgorids. The female of this species usually sits on the egg mass laid by it on the twig of *Acacia arabica*. While laying eggs the female cuts the bark longitudinally and inserts eggs into the twig in two parallel rows on either side of the slit and placing them at an acute angle to the main axis. The micropylar end of the egg is exposed.

Careful examination of the tree twigs revealed many females sitting over the eggs. The tree was marked and the females were observed closely for several days. After about three weeks the little ones were out and on account of their gregarious habit they grouped a little above the egg shells and the mother had moved a little away from the egg mass but was still amidst the young treehoppers.

The mother always sat tightly perched over the egg mass least disturbed by approaching animals or man. It did not move away even if the twig was shaken violently. It could only be removed from its place through a physical push. If any object was gently directed at it with the purpose of inducing it to move away from the egg mass, it usually retaliated and tried to push it aside with its pronotal horns. The female was observed to get extremely agitated on sighting minute hymenopterous egg parasites which threatened to parasitise the eggs. The female used to push aside the hymenopterous egg parasites with the help of its pronotal horns and by the movement of wings and legs.

It was apparent that the mother never leaves its eggs even temporarily till they are hatched and it may also be assumed that the brood mothers remain foodless during the period of maternal care as very careful observations have failed to reveal any punctures in the twig in front of them.

Maternal care in this species can be attributed to the fact that eggs of membracids are frequently parasitised by the hymenopterous parasites. In order to protect the eggs from parasitisation by these insects the female sits over the eggs. In this context the observation that the most of the eggs that remain uncovered are parasitised by the hymenopterous parasite is revealing. So it can be safely concluded that this instinctive type of maternal care exhibited by *O. tarandus* pertains to the protection of its eggs from the attack of its enemies.

Murtfeldt (1887)[1] observed the female of *Eutilia sinuata* Fabr., a membracid, hovering over a cluster of her eggs laid on the leaf of Ragweeds (*Ambrosia*). He found the parent insect remaining with her eggs and young leafhoppers. When the female was touched with finger even with all the shaking and brushing the mother was not dislodged.

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We are thanful to University Grants Commission for the grant of a fellowship to one of us (S.K.S.).

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[1] MURTFELDT, MARY E. (1887): Traces of maternal affection in *Eutilia sinuata* Fabr. *Ent. Amer. 3*: 177-178.

23. *PARNARA* BUTTERFLY FROM PATNA: A CORRECTION

In our faunal list of butterflies from Patna (Bihar) published in this *Journal* (Varshney and Nandi 1977), the occurrence of *Parnara guttatus bada* (Moore) has been shown in the Family Hesperiidae. According to Evans (1949) the species *guttatus* is now almost restricted to China, Japan, Sumatra etc. eastern countries. Only one subspecies *guttatus mangala* Moore is found in India, which too has limited distribution — Kashmir to Kumaun, Sikkim, Assam.

The subspecies *bada* Moore, which is common in peninsular India, has been placed under the species *naso* Fabricius. The type material of *bada* came from Ceylon (Sri Lanka) and it has been collected all over India, except western parts, *vide* Evans (1949). Thus, the Patna material should rightly be named as *Parnara naso bada* (Moore).

Evans (l. c.) has pointed out that the figures given of *guttatus* in Seitz (1927) also belong to *naso bada*.

We are thankful to the Director, Zoological Survey of India, for providing facilities and permission to publish this note.

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REFERENCES

EVANS, W. H. (1949): A Catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum (Natural History). London: 1-502 (p. 435).

SEITZ, A. (1927): Macrolepidoptera of the World. Vol. 9—Indo-Australian Region.

VARSHNEY, R. K. AND NANDI, B. (1977): Butterfly fauna of Patna (Bihar). *J. Bombay nat. Hist. Soc.*, 73(2): 325-328.

24. OCCURRENCE OF *ARTEMIA SALINA* (CRUSTACEA: PHYLLOPODA) IN DIDWANA LAKE, RAJASTHAN

Recently, the study of *Artemia* has gained importance because of its utility as food in aquaculture. *Artemia* nauplii constitute the best available source of live food for the young stages of most cultured species of larval fishes and decapods (Bardach 1972, Godwin 1976). There has been a numbr of records of *Artemia* from salt pans near sea coast in India. But barring Baid's (1958) record of *Artemia salina* from Sambhar lake in Rajasthan, there is no record of its occurrence from other inland salt lakes. During the course of a limnological study of two major salt lakes of the country, namely Sambhar and Didwana (Rajasthan), we found *A. salina* in Didwana lake. It is the first record of its occurrence from this lake. But, surprisingly, *A. salina* was not found in Sambhar lake by us.

The study of Didwana lake was conducted from March to May 1979. Water samples were collected in the first week of each month and analysed for chemical factors such as pH, dissolved oxygen, alkalinity and salinity. pH was measured by a battery-operated pH meter, dissolved oxygen by Miller's method (as suggested by Walker *et al.* 1970), alkalinity and salinity after APHA (1975). For collection of zooplankton, 50 litres of water were filtered through a bolting silk net (0.3 mm mesh size) and zooplankton thus collected preserved in 4% formalin.

The data of the physico-chemical factors are given in Table 1. During the course of the study, with the advance of summer, salinity and total alkalinity tremendously varied from one month to another. Dissolved oxygen was

TABLE 1

PHYSICO-CHEMICAL FACTORS OF DIDWANA LAKE DURING MARCH-MAY 1979

	March	April	May
Air temperature (°C)	24.5	35.0	30.0
Water temperature (°C)	23.0	26.5	26.5
pH	8.2	8.5	9.5
Dissolved oxygen (ml/L)	2.24	1.45	0.6
Total alkalinity (ppm)	1738	2920	3700
Carbonate alkalinity (ppm)	870	1240	2000
Bicarbonate alkalinity (ppm)	868	1680	1700
Salinity (‰)	108.0	170.0	268.0

found to be inversely related with alkalinity, salinity, pH and water temperature.

A. salina was the only zooplankter found in the samples. During the first sampling 40 specimens were found—all live adults. In the second sampling 150 specimens were collected, mostly larval stages with 50% dead individuals. In the third sampling only cysts were found. By this time the salinity had increased to 268‰ and lake water assumed the form of saturated brine. The death of the specimens occurred some time between the second and fourth weeks of April due to the high salinity and alkalinity and paucity of dissolved oxygen.

During the study period, two types of individuals of different size and colour were found. The males were pale yellow and shorter in size while the females were reddish in colour and longer. Probably they feed on *Aphanotheca* sp., *Anabaena* sp. and *Nitzschia* sp. as these were the only phytoplankton present in the lake. The data (Table 1) reveal that the maximum limit of tolerance for salinity lies between 170 and 268‰ and for alkalinity 2920-3700 ppm. Baid (1958) reported maximum salinity tolerance limit for *Artemia salina* to be 194.3‰ at Sambhar lake. But during the course of our 15 month's study (from April, 1977 to June, 1978) of Sambhar lake, the maximum salinity was only 15% and *A. salina* was totally absent. The disappearance of *Artemia* might be due to drastic changes in ecological conditions, mainly the decrease of salinity, owing to heavy rainfall and flood conditions for 3 to 4 years from 1975 onwards.

Our thanks are due to Prof. S. D. Misra, Head, Department of Zoology, University of Jodhpur for guidance and to Dr. J. Royan, National Institute of Oceanography, Dona Paula, Goa for help in identification of the species. Thanks are also due to U.G.C. for financial support to M. Alam.

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REFERENCES

AMERICAN PUBLIC HEALTH ASSOCIATION (1975): Standard Methods for the Examination of Water and Waste Water. APHA, 14th ed. Washington.

BAID, I. C. (1958): Occurrence of *Artemia salina* in Sambhar Lake, Rajasthan. *Curr. Sci. 27*(2): 58-59.

BARDACH, J. E. RYTHER, J. H. & MCLARNEY, W. O. (1972): Aquaculture; The Farming & Husbandry of Fresh Water and Marine Organism. Wiley Interscience. New York.

GODWIN, H. L. (1976): Proc. First Int. Conf. Aqua. Nut., Delaware (USA).

WALKER, K. F., WILLIAMS, W. D. AND HAMMER, U. T. (1970): The Miller method for oxygen determination applied to saline lakes. *Limnol. Oceanogr. 15*: 814-815.

25. ON A SMALL COLLECTION OF LEECHES COLLECTED DURING THE DAPHABUM AND SUBANSIRI EXPEDITIONS, ARUNACHAL PRADESH

The present note is based on a small collection of leeches collected by one of us (JMJ) as a member of the multidisciplinary scientific survey expeditions to hitherto unexplored areas of Daphabum (Lohit Distt.) and Subansiri in Arunachal Pradesh. The leech fauna of Arunachal Pradesh is known only from the contribution of Chandra (1970) who records five species, viz., *Haemadipsa montana, H. sylvestris sylvestris, H. zeylanica zeylanica, H. zeylanica agilis* and *H. zeylanica montivindicis* from the Kameng District. Except *H. zeylanica zeylanica,* all these species are re-recorded in the present communication. In addition, two species, viz., *Paraclepsis praedatrix* and *Herpobdelloidea lateroculata* are being recorded for the first time from Arunachal Pradesh.

Family GLOSSIPHONIDAE

Paraclepsis praedatrix Harding

Material.— 1 ex; Glo-Howel Lake, about 4 km. from Tihun (Lohit Distt.); alt. 1170 m; 9.xii.69.

Remarks.— This is the first record of *Paraclepsis praedatrix* from Arunachal Pradesh. It is generally found attached to submerged articles in lakes, tanks, pools and small streams. It often attacks molluscs, amphibians and reptiles.

Distribution.— *India*: Glo-Howel Lake (present record) in Arunachal Pradesh; Assam; Bihar; Haryana; Himachal Pradesh; Rajasthan; Maharashtra; Karnataka.

Family HERPOBDELLIDAE

Herpobdelloidea lateroculata Kaburaki

Material.— 4 ex; Wakro (Lohit Distt.); under stones in the vicinity of a hill stream; alt. 510 m; 1.xii.69.

Remarks.— This is the first record of *Herpobdelloidea lateroculata* from Arunachal Pradesh. In field, this species can be easily recognised by its planarian-shaped body. It mainly feeds on insect larvae, planktonic crustaceans and debris.

Distribution.— *India*: Wakro (present record) in Arunachal Pradesh; Manipur; Madhya Pradesh; Rajasthan; Maharashtra.

Outside India: Burma.

Family HAEMADIPSIDAE

Haemadipsa montana Moore

Material.— 1 ex; Tihun (Lohit Distt.); under stones near a stream in a dense forest; alt. 1260 m; 13.xii.69.

Remarks.—*H. montana* inhabits mountain forests. This species is reported to attack cattle and man. The colour ornamentation on the dorsum is mainly of a black median and a pair of lateral white longitudinal stripes.

Distribution.— *India*: Moshing, Domkho, Shergaon and Chug valleys in Kameng Distt. (Chandra, 1970), and Tihun in Lohit Distt. (present record) in Arunachal Pradesh; Sikkim; Darjeeling Hills in West Bengal; Palni Hills in Tamil Nadu.

Haemadipsa sylvestris sylvestris Blanchard

Material.— 3 ex; Chowkham (Lohit Distt.); under stones on the bank of Berang river; alt. 242 m; 22, 23.xi.69. 2 ex; Wakro; alt. 510 m; 1.xii.69.

Remarks.— This land leech is known to attack fresh-water crabs, cattle and man. The colour in living specimens is brownish with three black longitudinal stripes on the dorsum.

Distribution.— India: Amatulla, between Jhumla and Moshing, Dorkochu, Shergaon village, Sangloo and Domkho in Kameng Distt. (Chandra 1970) and Chowkham, Wakro in Lohit Distt. (present record) in Arunachal Pradesh; Assam; Sikkim; W. Bengal; Uttar Pradesh; Meghalaya.

Outside India: Burma, Indonesia.

Haemadipsa zeylanica agilis Moore

Material.— 1 ex; Damin (Subansiri Distt.); under stones near a stream; alt. 1100 m; 20.i.75.

Remarks.— H. z. agilis is commonly found in forests and grasslands. It is known to attack cattle and man, and can be easily recognised by the dark-blotched pattern on the dorsum.

Distribution.— India: Ankaling village in Kameng Distt. (Chandra 1970), Damin in Subansiri Distt. (present record) in Arunachal Pradesh; Uttar Pradesh; Himachal Pradesh; Tamil Nadu; Kerala.

Outside India: Nepal.

Haemadipsa zeylanica montivindicis Moore

Material.— 2 ex; Tihun (Lohit Distt.); under stones near a stream in a dense forest; alt. 1260 m; 13.xii.69.

Remarks.— This species is very common in forests of the eastern Himalayas. It often attacks cattle and man. Dark-blotched pattern on the dorsum is obscure or absent.

Distribution.— India: Ankaling village in Kameng Distt. (Chandra 1970), Tihun in Lohit Distt. (present record) in Arunachal Pradesh; Sikkim; Assam; W. Bengal.

Outside India: Nepal, Burma.

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REFERENCES

CHANDRA, M. (1970): Notes on a small collection of leeches in the Zoological Survey of India. *Rec. zool. Surv. India, 64*: 107-109.

26. SOME INTERESTING OBSERVATIONS ON A SPIDER *ARGIOPE ARCUATA* SIMON (ARACHNIDA: ARANEIDAE)

During the course of desert locust survey conducted along the Indo-Pak border area during August-September 1976, some interesting observations were recorded on an orb weaving spider, *Argiope arcuata* Simon.

Habitat: The habitat of this spider was in most difficult and inaccessible desert tracts comprising high sand dunes with narrow basins. Even in this habitat their population was confined to the narrow basin and lower edges of the sand dunes as the population of Acridids was heavy in the areas. Not a single spider was detected at the top of the high sand dunes or their upper slopes. The webs were mostly found on woody shrubs growing in the basins but sometimes they were also seen on luxuriantly growing herbs such as *Boerhavia elegans* Choisy. The habitats of grasshoppers and that of this species of spider are almost the same.

Food and feeding habits: The web formed by this spider is an efficient trap even for very large insects; the gossamer being quite strong. In its web, nymphs and adults of grasshopper such as *Acrotylus* sp., *Oedaleus* sp., *Chrotogonus trachypterus, Thisioecertus littoralis, Ochrilida* sp., *Truxalis exima exima,* bugs, dung rollers and other beetles, some unidentified caterpillars and that of *Celerio* sp. were detected. At two places *Solitaria* hoppers of 4th instar of the desert locust were also found. On one occasion one *Truxalis* adult got entangled in its web but by struggling hard it escaped. It is interesting to note that large insects such as grasshoppers etc. when trapped in the web are further rendered helpless by being speedily fastened with silky thread on the legs and wings of the prey insect by the spider, and this ultimately causes death of the prey.

As many as eight insects were found in the skins of one web. Bhatia and Singh (1966)[1] recorded *Argiope* sp. as predator of the desert locust adults and hoppers from Bikaner district but it is not known to which species, the spider belonged. It appears that many species of *Argiope* may be predating on nymphs and adults of grasshoppers and desert locust.

Cannibalism: Some instances of cannibalism were also observed.

Predators: Lizards are predators of this spider. Several specimens of *Acanthodactylus cantoris cantoris* and Skink *Ophiomorus tridactylus* and *Calotes versicolor* were dissected and spiders of this species were found in their gut contents. Some passerine birds also predate upon these spiders when they move from one place to another.

Population: I have frequently visited border areas of Barmer and Jaisalmer districts from 1974 to 1977 but only during August-September 1976 a significant population of this spider was noted. Maximum number of spiders per bush was two individuals. Prior to 1976, a web of this spider was seldom seen; obviously populations were extremely low, thus escaping notice.

The number of the spiders was generally five per square metre in Dhanana-Murar area (Jaisalmer). The population explosion (approximately 2000 per hectare) observed during 1976 was most probably due to availability of ample insect food and good vegetation during 1975 to 1976 in view of good rains.

Distribution: The spiders of this species have been collected from Sundra area of Barmer district and Dhanana-Murar area of Jaisalmer district during September 1976. It was commonly met with in the desert belt from Sundra (Barmer) 25° 05′ N, 71° 07′ E to Dhanana-Murar (Jaisalmer) 26° 42′ N, 70° 12′ E during 1976. It is just possible that the belt of its distribution may be further extended into Bikaner district along the Indo-Pak border, being of similar terrain, vegetation and insect fauna. This appears to be the first record of its occurrence from these districts.

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I am obliged to Dr. B. K. Tikader, Deputy Director, Zoological Survey of India, Western Regional Station, Poona for identification of the spider and scrutiny of the manuscript and

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[1] Bhatia, D. R. & Singh, Charan (1966): Natural enemies of the desert locust (*Schistocerca gregaria* Forsk.). *Plant Protection, Bull.* 18 (1-2): 14-17.

helpful suggestions. I am thankful to Dr. S. N. Banerjee, Plant Protection Adviser to the Government of India, Faridabad for the facilities.

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27. OBSERVATIONS ON THE SILK CHAMBER CONSTRUCTION AND BROODING BEHAVIOUR OF PSEUDOSCORPIONS (CL. ARACHNIDA)

(*With five text-figures*)

It is the habit of pseudoscorpions to build chambers of silk which are used for breeding, moulting and hibernation (Gabbutt and Vachon 1965). The silk chamber is generally constructed with the help of the spinneret or galea, situated at the distal end of the fixed finger of chelicera (fig. 1a). The silk glands lie in the prosoma and ducts pass along the fixed finger and open at the tip of the galea (fig. 1b) or the spinneret. Savory, T.H. (1935) pointed out the homology of the silk apparatus with that of the poison apparatus of Araneae. It is to this presence of the silk glands in the chelicerae, the false scorpions owe the name chelonethi, given by Thorell.

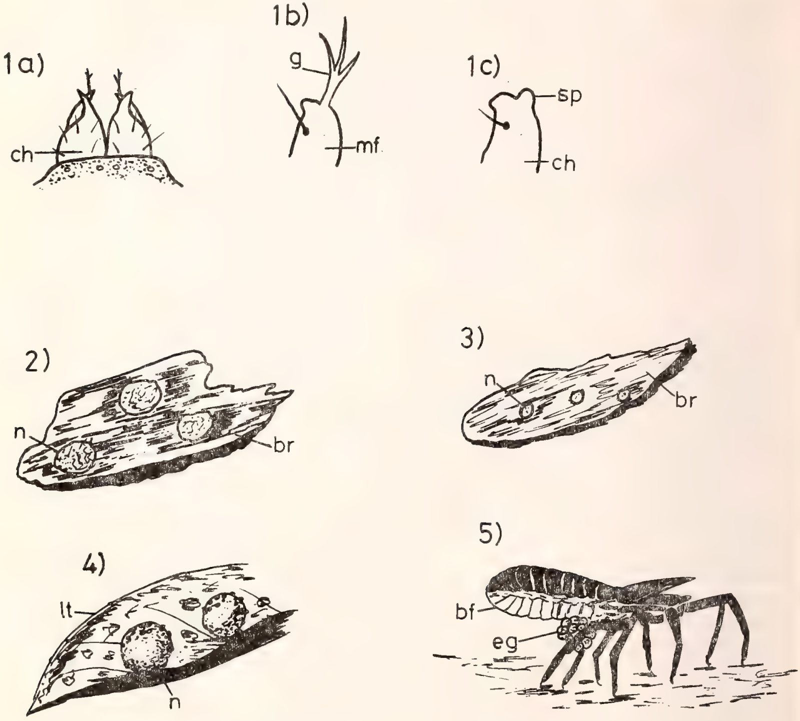
By the issue of silk glands, the chambers of silk are constructed in damp places underneath the barks of trees by the bark dwelling forms or under decaying leaves of debris by litter inhabiting pseudoscorpions. It is of interest to know whether the method of construction, the period of nesting and the reaction towards external disturbance differ among the members of the three different suborders namely *Monosphyronida, Diplosphyronida* and *Heterosphyronida,* inhabiting different habitats. Furthermore, extensive work has been done in the field of population dynamics of pseudoscorpions in different parts of the world (Kew 1914; Morikawa 1962; Gabbutt and Vachon 1965). However, during the studies they have failed to take into consideration nested forms, which may influence the population fluctuation remarkably. In this connection, a statistical allowance has been thought of during the present investigation.

METHODS

Tullgrenius indicus, Calocheiridius elegans and *Lechytia indica* were taken up for observation as members of the suborders namely Monosphyronida, Diplosphyronida and Heterosphyronida respectively. For each species 10 individuals were observed at the time of nesting, moulting, brooding and hibernation with reference to their behaviour variations.

OBSERVATIONS

Tullgrenius indicus: (Table-1): This species was seen beneath the bark of tamarind trees. During breeding season, the gravid female carries 10 to 12 eggs attached to the genitalia as a spherical mass and covered by a thin membrane. With the help of the branched galea the female deposits the silk in an irregular fashion between the stem and the bark



Figs. 1-5. 1) Chelicerae of *Tullgrenius indicus;* 1b) galea; 3) spinneret of *Lechytia indica.* 2) Nests of *T. indicus.* 3) Nests of *Calocheiridius elegans.* 4) Nests of *L. indica.* 5) *T. indicus* female carrying eggs.

Abbreviations

bf—brooding female of *Tullgrenius indicus,* br—bark of tree, ch—chelicera, eg—egg cluster, g—galea, lt—litter, mf—movable finger, n—nest, sp—spinneret.

of the tree. The deposition of sand grains and tiny bark particles over the completed nest have been observed. The males and the females hibernate during winter (December and January), but the females club the brooding during that period. At a time, below a bark 5 to 7 nests have been observed with the least gap of 0.5 mm between two nests. Invariably the ramification of the hyphae of saprophytic fungi like *Penicillium* and *Aspergillus* have been observed over the silken chambers. (Fig. 2).

After about four weeks the protonymphs hatch from the eggs and remain with the mother inside the nest and they feed on the exudation from the mother. During moulting the three nymphal stages (Protonymph, deutonymph and tritonymph) build nests and the diameter of the nest varies from 6 to 8.5 mm. The brooding female constructs the largest chamber.

Calocheiridius elegans: (Table 1): This species occurs beneath the bark of tamarind trees. During the breeding season the gravid female extrudes 6 to 8 eggs which remain attached to the genitalia and present a roussette-like appearance.

At that time, the gravid female, with the help of the galea issues sticky silk and screens the gap between the stem and the bark of the tree. The deposition of coarse wood particles over the completed nest has been observed. The males and females hibernate during winter, during that period the females also exhibit the brooding of eggs while in the silken chamber. At a time, 4 to 5 nests have been observed below a piece of bark with the least gap of 4 cm. Fungal growth over the nest has been observed in this species also (Fig. 3).

After about three weeks the protonymphs hatch from the eggs and remain with the mother till moulting. The nymphs also build nests during moulting and the size of the nest varies among the three nymphal stages. The diameter of the nest varies from 2.5 to 4 mm and the brooding female constructs the largest nest.

Lechytia indica: (Table 1): This species was observed beneath decaying leaves of soil litter. During brooding, the gravid female having 5 to 6 eggs as globular mass, moistens the leaf with silk from the spinneret (fig. 1c). Gradually debris and sand particles deposit over the wet silk. Some times the nest appears like a ball of insect faecal matter. The size varies from 1 to 3 mm in diameter (Fig. 4).

Since winter migration from litter to soil is predominant and is subsequently followed by hibernation in silken chambers, the individuals are fewer in number during sampling.

In all these forms, when the nest is disturbed the animal comes out immediately and in the case of brooding female the brood sac is discarded. (Fig. 5). Besides, they cease to construct another silken chamber for a minimum period of 20 days. When the nymphal forms undergoing moulting were disturbed, they died within a period of 2 hrs. due to lack of chitinization. The body cavity of the dead animals showed the presence of fungal hyphae.

DISCUSSION

The Chelonethi use their nest solely for protection and the form of construction varies. Among bark inhabiting pseudoscorpions, *Tullgrenius indicus* and *Calocheiridius elegans* there is lesser deposition of sand grains or wood particles on their nest, whereas in *Lechytia indica*, a litter inhabitant, the deposition of decaying matter and sand grains is more, which gives strength and protection to the nest. In bark dwelling forms probably due to

TABLE 1

THE NATURE OF SILK CHAMBER CONSTRUCTION AND THE PERIOD OF NESTING AMONG PSEUDOSCORPIONS

Suborder and name of species	Silk issuing organ of chelicera	Shape of the nest	Diameter of nest (in mm)	Additional substances	Period of nesting in days
MONOSPHYRONIDA					
Tullgrenius indicus	branched galea	irregular	6 to 8.5	Coarse sand and wood particles	21 to 30
DIPLOSPHYRONIDA					
Calocheiridius elegans	branched galea	circular	2 to 4	Coarse wood particles	20 to 24
HETEROSPHYRONIDA					
Lechytia indica	spinneret	globular	1 to 3	Sand particles and decaying matter	30 to 50

the availability of controlled microclimate, the additional substances are not much utilized. It may be inferred here that the variation in the mode of construction of silken chamber depends upon the habitat of the pseudoscorpion.

Further pseudoscorpions undergo nesting during winter and the nymphs moult throughout the year. Similar conditions that influence the population study of pseudoscorpions, have been observed in the life history analyses of pseudoscorpions by Gabbutt and Vachon (1965). In this connection Gabbutt (1970) has stressed the inclusion of nested forms in population recordings to arrive at a probable figure. The suggestion of Gabbutt (1970), does not seem to be sound since it has been observed that the encumbered female rejected the brood-sac when disturbed, thereby depleting the number of individuals during the next sampling. In addition, the mortality rate of nymphs increases when the nests are disturbed during collection.

Thus, the present study suggests that nested forms should not be disturbed during population analysis and a statistical modulation could be introduced inorder to incorporate the nested forms in the population dynamics.

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REFERENCES

Gabbutt, P. D. & Vachon, M. (1965): The external morphology and life history of the pseudoscorpion *Neobisium muscorum*. *Proc. Zool. Soc. Lond. 145*: 335-358.

Gabbutt, P. D. (1970). Sampling problems and the validity of life history analysis of pseudoscorpions. *J. Nat. Hist. 4*: 1-15.

Kew, H.W. (1914): On the nest of pseudoscorpions with historical notes on the spinning organs and observations on the building and spinning of the nests. *Proc. Zool. Soc. Lond. 1914*: 93-111.

Morikawa, K. (1962): Ecological and some biological notes on Japanese Pseudoscorpions. *Mem. Ehime. Univ.* Vol. IV. No. 3: 417-35.

Savory, T. H. (1935): Arachnida. Academic Press, London, 1-291.

Weygoldt, P. (1969). The biology of psudoscorpions. *Harvard. Univ. Press.*, 1-145.

28. SOME INTERESTING OBSERVATIONS IN *WRIGHTIA TINCTORIA* R.BR. SSP. *TINCTORIA*

(*With a text-figure*)

An interesting specimen of *Wrightia tinctoria* R. Br. ssp. *tinctoria* was collected by the senior author from Kumbharli ghat, about 12 kms from Koyna, Maharashtra during a botanical exploration tour in April 1978.

The species *W. tinctoria* R. Br. has been divided into two subspecies namely ssp. *tinctoria* and ssp. *rothii* by P. T. Pgan (1965). The specimen (Nayar 153166) collected from Kumbharli ghat differs from *W. tinctoria* ssp. *tinctoria* in the following characters:

1) Inflorescence less lax
2) Pedicel not exceeding 12 mm.
3) Corolla lobes acute
4) Corona segments not distinguishable as supplementary segments and alternipetalous segments.

The most interesting observation made was on the nature and arrangement of the corona segments. Pgan (1965) has described the structure of corona in *W. tincotria*, wherein he has explained the arrangement of corona segments in three distinct series, i.e. supplementary segments, alternipetalous segments and antepetalous segments. Pgan had noticed some variations in the corona segments of *W. tinctoria* (Fig. 1, A-A3).

The variations observed in the corona segments of the specimen (Nayar 153166), however do not agree with any of the variations as shown in fig. 1 (A-A3). On a critical study it was observed that the corona segments

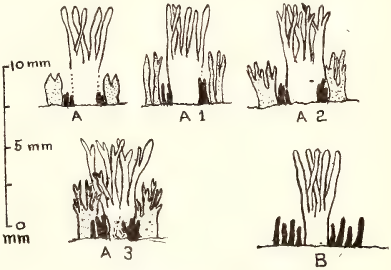


Fig. 1. A-A3: Diagrams showing variation in corona structure; antepetalous segments white, alternipetalous segments dotted; supplementary segments solid black.

B: Diagram showing an inner row of segments (solid black) indistinguishable as alternipetalous segments and supplementary segments; antepetalous segments white.

are not clearly distinguishable as supplementary segments and alternipetalous segments (Fig. 1-B). In this case the true alternipetalous nature of corona segment is not observed, only an inner series of corona segments of variable lengths (not exceeding 2 mm) and an outer series of antepetalous segments are seen.

These interesting observations can be interpreted as a result of hybridization as suggested by Pgan or due to abberation.

The specimen (Nayar 153166) is deposited in the herbarium of the Botanical Survey of India, Poona (BSI).

ACKNOWLEDGEMENT

The junior author wishes to thank the Director, Botanical Survey of India for awarding him a Research scholarship.

M. P. NAYAR
R. K. KOCHHAR

BOTANICAL SURVEY OF INDIA,
POONA-411 001.
December 30, 1978.

REFERENCES

PGAN, P. T. (1965): A revision of the genus *Wrightia* (Apocynaceae). *Ann. Missouri Bot. Gard.* *52* (2): 114-175.

29. *VERNONIA CHINENSIS* LESS.—A NEW RECORD FOR ANDAMANS

Vernonia chinensis Less. is known from Malay peninsula, Burma, China and Philippines. During re-organisation work we noticed a few specimens collected from South Andaman which after critical study were identified as *Vernonia chinensis;* a first record for Andaman.

The plant is characterised by tomentose slender, terete branches, leaves petioled elliptic or ovate-elliptic 2.5-7.5 cm. × 1.5-3.5 cm., puberulous, serrate, bracts pubescent, lanceolate, awned, receptacle pitted, achene small, 4-5 ribbed, glabrous.

Vernonia chinensis Less. in Linnaea, IV. 674, Miq. Flor. Ind. II p. 18; Clarke, comp. Ind. 18:1876; Flora Brit. Ind. 3; 235: 1881. *Cyamosa pubescens* and *Cyanopsis villosa* DC., v. p. 69; *Conyza punctulata,* Wall. list 2995.

Specimens examined:

Tavoy, 4 nov. 1829, Wall. list 2995; Burma, *Kurz* 843, *Kurz* 2237 (CAL); Malay Peninsula, *King's collector* 1120 (CAL), *Hook*. 1325 (CAL). Philippines, *Elmer* 8209, *Lohr* 3686, *Kobbi* 6582 (CAL); Andaman: North Bay, Hill jungle, *Dr. King's Collector,* 8-9-1895, s.n. (CAL).

BIMALENDU MITRA
GIRIJA SANKAR GIRI

BOTANICAL SURVEY OF INDIA,
HOWRAH-711 003,
May 16, 1978.

30. A NEW DISTRIBUTIONAL RECORD FOR *EUPATORIUM ADENOPHORUM* SPRENG. FROM TEHRI GARHWAL

During a recent survey of, 'The Flora of Tehri Garhwal,' *Eupatorium adenophorum* Spreng., a weed belonging to family Compositae was found growing in moist and shady situations at Vyasi, in the Tehri Garhwal, at an altitude of 455 metres. It is being reported for the first time from this region. This weed is a native of Mexico and Jamaica. It was introduced as a garden plant about 1924 but within recent years has run wild and naturalized.

The distribution of the taxon is not widespread in the area and its migration seems to be recent to the area.

Eupatorium adenophorum Sprengel, Syst. Veget. 3: 420, 1826; Koster in Blumea 1 : 502, 1935. Hara in Fl. E. Himal. 137, 1971.

An erect, perennial branched undershrub. Branches cylindrical, densely glandular hairy. Leaves opposite, petioled, sharply pointed, coarsely serrate above the cuneate base, 2.5-9 cm. long. Corymbs fastigiate trichotomous, flower heads clustered, white, pedicelled, 40-70 flowered, slightly fragrant, receptacle flat, involucral bracts about 20 in two rows, lanceolate. Corolla tube white, 1 mm., slender, abruptly dilated. Achenes black glabrous, slender, crowned by a pappus of 10-12 white scabrid hairs, twice as long.

Flowers and Fruits: March-July.

Specimen examined: Dhyani 115, 28-3-1976. Collected from Vyasi, Tehri Garhwal.

ACKNOWLEDGEMENT

I am indebted to Prof. Som Deva for his invaluable help.

SHIV KUMAR DHYANI

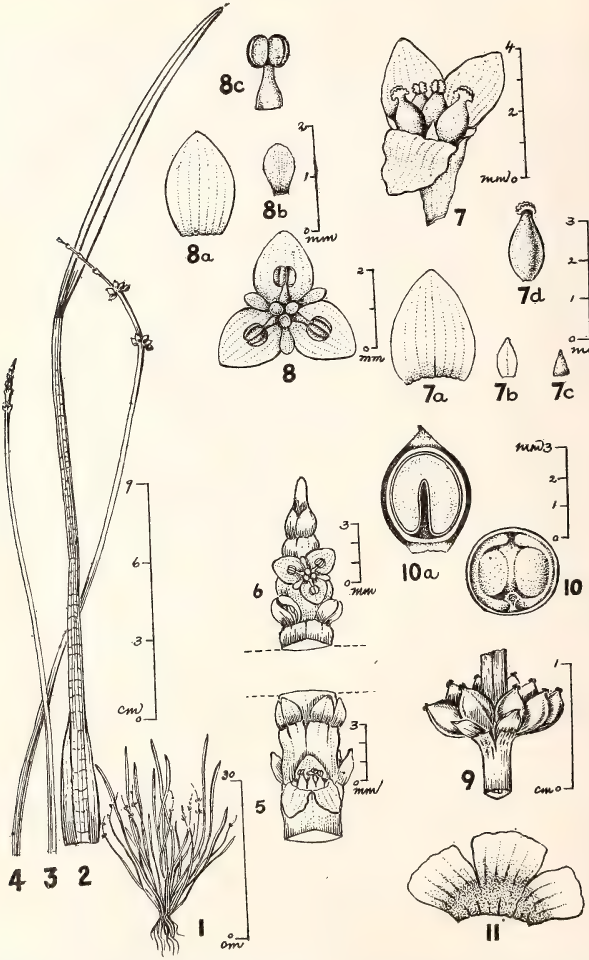
DEPATMENT OF BOTANY,
D. A. V. (P.G.) COLLEGE,
DEHRADUN-248 001.
May 15, 1978.

31. *WIESNERIA TRIANDRA* (DALZ.) MICHELI (ALISMATACEAE) —AN INTERESTING AND RARE ADDITION TO THE FLORA OF THE PRESIDENCY OF MADRAS, FROM KERALA, SOUTH INDIA

(*With eleven text-figures*)

The genus *Wiesneria* Micheli is represented so far by four species throughout the world. Out of which only one species is recorded (from Konkan, Western Peninsula) in India hitherto. There is every possibility that an intensive search for them in pools and ponds of Kerala may result in the discovery of the other allied species as well. The present paper with its detailed description incorporating intraspecific variation and analytical sketches would definitely facilitate in the search. This is an addition to the flora of erstwhile Presidency of Madras and thus this present discovery extends its distribution to the Southern most part of India.

Wiesneria triandra (Dalz.) Micheli in A. DC. Monog. Phan. 3 : 82-83. 1881; Benth. & Hook. in Gen. Plant. 3: 1007. 1883; Hook.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Figs. 1-11. *Weisneria triandra* (Dalz.) Micheli: 1. Whole plant; 2. Single leaf; 3. Inflorescence; 4. Infructescence; 5. Basal portion of the inflorescence (♀ flower with sepals spreadout); 6. Terminal portion of the inflorescence (♂ flowers); 7. ♀ flower: 7a. sepal, 7b. petal, 7c. staminode, 7d. gynoecium; 8. ♂ flower: 8a. sepal, 8b. petal, 8c. stamen; 9. Fruits (young); 10. C. S. of young fruit; 10a. L. S. of young fruit. 11. Bract from young fruit, spreadout (not to scale).

f. Fl. Brit. India 6: 562. 1893. Buchenau in Engler, Pflanzenr. 16: 60-61. 1903; Cooke, Fl. Press. Bombay 3: 346-347. 1958. (rep. ed.) *Sagittaria triandra* Dalz. in Hook. Journ. bot. and Kew Gard. Misc. 2: 144. 1850; Dalz. & Gibs. Bombay Fl. 249. 1861.

Aquatic plants in shallow water in paddy fields, gregarious, semi-submerged, caespitose, monoecious, rooted. *Roots* many, long, white spongy. *Leaves* radical, numerous, long petioled, linear, lamina shorter than the petiole, ligulate; *petiole* ± 20.0 × 0.6 cm, constricted at the joint with the lamina, obtusely trigonous in cross section, aerenchymatous, broadened into a sheathing base; *lamina* ± 14.0 × 0.7 cm, linear, keeled especially towards the base, obtuse at tip. *Inflorescence* raceme, ± 20 cm long, with long peduncle and very short floriferous portion, axillary, shorter than leaves, erect; *peduncle* ± 18 cm long, obtusely trigonous; flowering axis sharply trigonous with unisexual flowers arranged at very short intervals; floriferous portion ± 2 cm long, narrow with 5 or 7 whorls; lower 2 (or 3) whorls with pistillate flowers (or very rarely 3rd whorl with both sex flowers) and upper whorls with staminate flowers, sometimes the upper most whorls sterile, intervals of whorls (especially the lower ones) elongating very much after fertilization. *Flowers* white, bracteate, trimerous. *Female flowers* shortly pedicellate; *bracts* three, connate at base, ± 3.0 × 2.0 mm, erect, trapezoid, truncate and subentire at apex, slightly accrescent; *sepals* three not spreading, ± 3.0 × 2.0 mm, erect, ovate, obtuse, slightly accrescent in fruit; *petals* three, alternating sepals, ± 1.0 × 0.5 mm, ovate or obovate to ligulate, obtuse, persistent; *pistils* 3 or 4 (rarely less), ± 2.0 × 0.75 mm, flask shaped; *ovary* globose to ovoid, abruptly narrowed into a short neck and ending in a bilobed stigma; lobes of stigma broadly auricular, warted on the receptive surface; *staminodes* three, triangular, ± 0.75 mm long, thick, acute. *Male flowers* about 3.5 mm across; *pedicel* ± 1.75 mm long; *bracts* three, similar to those of female flowers; *sepals* three, spreading, ovate to obovate, slightly connate at base, obtuse to rounded at tip, subequal, longer one ± 2.0 × 1.25 mm; other two sepals ± 1.5 × 1.0 mm; *petals* three, much smaller than sepals, as large as the petals of female flower, obovate, rounded at tip; *stamens* three, antisepalous, ± 1.5 mm long; *filaments* ± 1.0 mm long, dilated towards base; *anthers* large, conspicuous, basifixed, anther lobes reniform; *pistillodes* usually three, ovoid. *Young fruits* subglobose or ovoid with short apical beak, one seeded; *embryo* curved.

Specimens examined: *Joseph* 44444 (BSI/SC acc. nos. 85768 & 85769), fallow paddy fields, near Kottur dairy farm, Trivandrum District, Kerala, 27-9-1973, + 300 m; *Stocks. Law* etc. *s.n.* (MH acc. no. 73292) Malabar, Concan etc.

ACKNOWLEDGEMENT

We wish to express our thanks to the Deputy Director, Central National Herbarium, Botanical Survey of India for confirming the identity of the specimen.

J. JOSEPH[1]
V. CHANDRASEKARAN

BOTANICAL SURVEY OF INDIA,
SOUTHERN CIRCLE,
COIMBATORE-2,
May 20, 1978.

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[1] *Present address*: Botanical Survey of India, Shillong, Meghalaya.

32. *CHLOROPHYTUM ARUNDINACEUM* BAKER (LILIACEAE) IN MAHARASHTRA

(*With five text-figures*)

Chlorophytum arundinaceum, (family Liliaceae) was newly collected from Chandrapur district, Maharashtra. The species has not been earlier recorded by Cooke (1901-08) or by Haines (1916).

In view of the absence of any known published illustration of the plant, a drawing is given along with a few salient points below, based on the study of our specimens (*see* text-figures on p. 173).

Chlorophytum arundinaceum Baker in Journ. Linn. Soc. 15: 323, 1876; Fl. Brit. India 6: 333, 1892.

Herb. Leaves lanceolate-oblanceolate. Scape long, racemes ± 12 cm long. Pedicels about 6 mm long in flower, 9-10 mm in fruit, articulated at or below the middle. Perianth outer 9-10 × 3 mm oblong or elliptic oblong. Inner 9-10 × 3.5 mm oblong-lanceolate, both five nerved. Anthers 6 mm long, filaments 2-3 mm long. Stigma simple. Capsule subglobose. *Fl. & Frt.*: July-October.

Loc.: Bhambra nallah (Allapalli) *Malhotra* 135799.

ACKNOWLEDGEMENTS

We are thankful to the Deputy Director, Botanical Survey of India, Western Circle, Pune, for facilities and to Shri M. Y. Ansari, Systematic Botanist, for helpful suggestions.

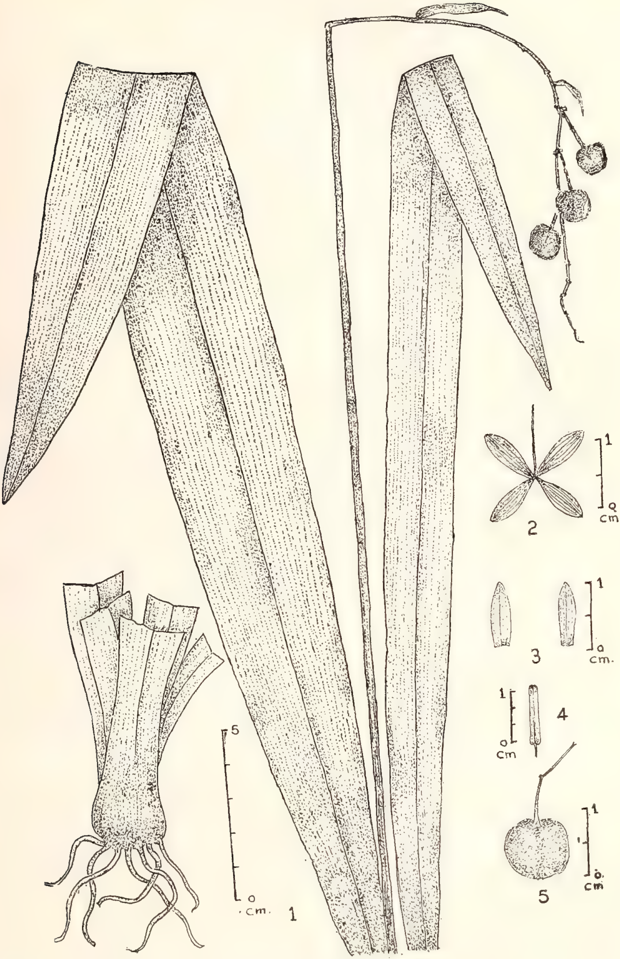
S. K. MALHOTRA
SIRASALA MOORTHY

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE, PUNE,
March 3, 1978.

33. NOMENCLATURE OF SOME BULBOUS LILIACEAE OF INDIA

In the Flora of British India, J. D. Hooker recognised 5 species under genus *Urginea* Steinh. Subsequently Blatter & McCann (1928) described *U. polyantha* from Western India and Boraiah *et* Fatima (1970) have added *U. govindappae* from Karnataka. However, during a recent revision of the genus from India, Deb & Dasgupta (1974) have reduced *U. coromandeliana* Hook. f. and *U. govindappae* as synonyms under *U. indica* (Roxb.) Kunth, with the result they recognise only 4 species in India, namely *U. indica, U. congesta* Wt., *U. polyantha* and *U. polyphylla* Hook. f.

Jessop (1977) while critically analysing the bulbous Liliaceae of Africa, is of the opinion that the genera *Urginea* Steinh., *Idotheae* Kunth, *Thuranthos* Wright, *Urgineopsis* Compton and *Drimia* Jacq. ex Willd. are closely allied to each other having no reliable constant distinguishing character to separate them and hence he preferred to treat them all under *Drimia* Jacq. ex Willd., the earliest valid name. The differences between *Urginea* and *Drimia* are essentially based on their perianth being reflexed or not, the nature of perianth tube and colour of the bulbs. The degree of fusion of the perianth tube considerably varies and overlaps in both the genera and although a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Figs. 1-5. *Chlorophytum arundinaceum* Baker: 1. Habit; 2 & 3. Perianth and Gynaecium; 4. Stamen; 5. Capsule. (For description *see* p. 172).

majority of the species under *Urginea* from India have only white bulbs, a few (from South Africa) have red bulbs as well. Further, in Indian species of *Urginea*, it is also observed that perianth segments are spreading and get reflexed either partially or wholly when fully opened. The arguments put forth by Jessop are convincing and equally apply to the Indian species of *Urginea*. As a result new combinations have been suggested for the other 3 Indian species, the one *Urginea indica* being already changed to *Drimia indica* (Roxb.) Jessop *comb. nov.* along with other 22 new combinations effected by Jessop (l.c.).

1. **Drimia congesta** (Wt.) Ansari *et* Raghavan *comb. nov.*

Urginea congesta Wt. Icon. t. 2064 (Left-hand fig.) 1853; Baker in J. Linn. Soc. 13: 218, 1873. Deb & Dasgupta in Bull. bot. Surv. India 16: 121-122. 1974.

2. **Drimia polyantha** (Blatt. et McC.) Ansari *et* Raghavan, *comb. nov.*

Urginea polyantha Blatt. et McC. in J. Bomb. nat. Hist. Soc. 32: 735. Deb & Dasgupta *l.c.* 122-123. 1974.

3. **Drimia polyphylla** (Hook. f.) Ansari *et* Raghavan, *comb. nov.*

Urginea polyphylla Hook. f. Fl. Brit. India 6: 348. 1892; Deb & Dasgupta *l.c.* 123. 1974.

ACKNOWLEDGEMENT

We are grateful to the Deputy Director, Botanical Survey of India, Western Circle, Poona for his kind encouragement.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE, PUNE,
May 16, 1978.

M. Y. ANSARI
R. SUNDARA RAGHAVAN

REFERENCES

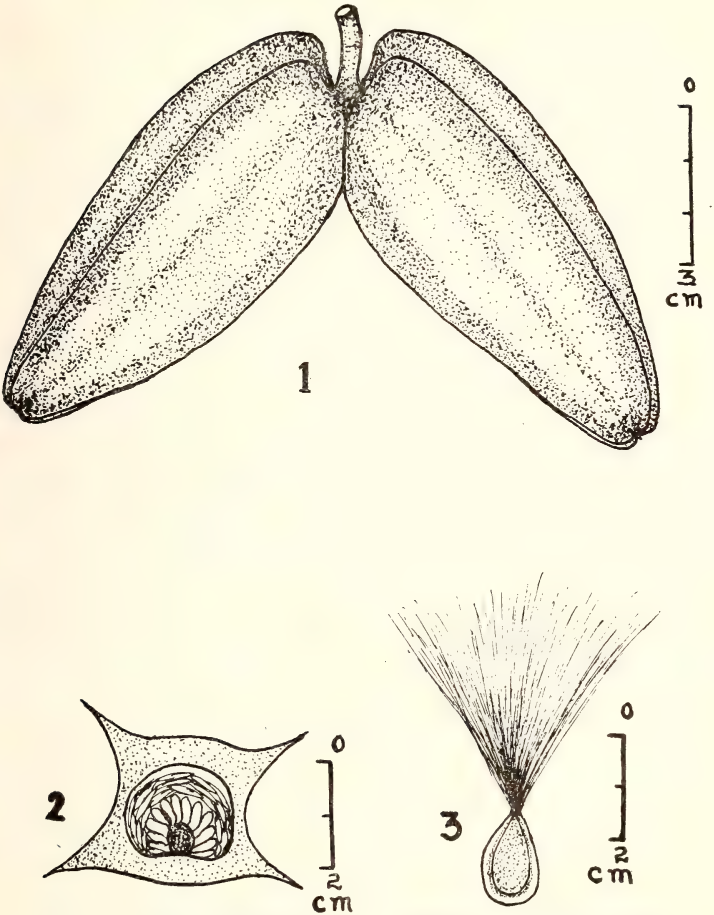
BORAIAH, G. & FATIMA, T. K. (1970): Cytotaxonomy of *Urginea govindappae* sp. nov. *Bull. bot. Surv. India 12*: 128-131.

JESSOP, J. P. (1977): Studies in the Bulbous Liliaceae in South Africa: 7. The taxonomy of *Drimia* and certain allied genera. *Jour. S. Afr. Bot. 43*(4): 265-319.

34. HITHERTO UNDESCRIBED FOLLICLES OF *MARSDENIA BRUNONIANA* WT. & ARN. AND ITS DISTRIBUTION

(*With three text-figures*)

R. Wight and G. A. Walker-Arnott (1834) described *Marsdenia brunoniana* without fruits based on his collections "*Wight! Cat. n.* 1524 —Prope Columala". It is understood from correspondence with Kew Herbarium that the 4 type sheets are of specimens all in flowering condition, as is another unnumbered sheet from Wight's herbarium; and only one sheet has the reference on distribution "Coromandel". In the literature the references on its distribution are "COROMANDEL, near Cotermala" (Hooker 1883); "Prope Columala" (Wight 1834); and "near Columala (Kollimalais?)" (Gamble 1923). Further there is no specimen of this species represented either in Madras Herbarium (MH) or in Central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Figs. 1-3. *Marsdenia brunoniana* Wt. & Arn.: 1. Follicles; 2. C. S. of fruit to show the winged angles; 3. Seed.

National Herbarium (CAL). Thus the exact locality of its occurrence has not yet been clearly indicated in the floras by J. D. Hooker (1883) and J. S. Gamble (1923); also the description on the fruits of this species is not available in literature since there was no collection with fruits.

Surprisingly the occurrence of this species was recently noted by the senior author on the northern slopes of Palni hills during a plant exploration trip, and collected with flowers during October 1977 and with fruits during February, 1978. Thus the rare and interesting species has been rediscovered after a lapse of over 100 years. Since the fruits of this species are not known so far, a short description of them with figures has been provided.

Marsdenia brunoniana Wt. & Arn. in Wt. Contr. 40. 1834; Wt. Ic. t. 356. 1840; Dcne. in DC. Prodr. 8: 614. 1844; Hooker, Fl. Brit. India 4: 36. 1883; Gamble, Fl. Pres. Madras 846. 1923 & 2: 594. (rep. ed.) 1957. Follicls 8-9 × 3-5 cm, green, ripe pale yellow, two or solitary, ovatelanceolate, 4-angled, angles sharply winged, smooth, glabrous, obtuse, slightly indented at apex, truncate at base; seeds 1-1.5 × 0.7—1 cm, many, black, white-margined, ovate-elliptic, flattened, subobtuse at apex, with white silky coma up to 4.5 cm long. (Figs. 1-3).

Field note: This climbing shrub grows over small trees in scrub jungles at an altitude of ± 700 m. Fruits are quite distinct in having 4-winged angles.

Specimens examined: INDIA. TAMIL NADU: Madurai Dt., Poomparai-Vilpatti R. F., 18-10-1977, *Chandrabose* 51367; Palani-Kodaikanal, 17-2-1978, *Chandrabose* 53371.

ACKNOWLEDGEMENTS

We are grateful to the Director, Royal Botanic Gardens, Kew, England for providing the details on the type specimens of the above species and to Dr. A. N. Henry, Systematic Botanist, Botanical Survey of India, Coimbatore for help.

BOTANICAL SURVEY OF INDIA,
COIMBATORE,
TAMIL NADU,
December 29, 1978.

M. CHANDRABOSE
N. C. NAIR

35. MORE RECORDS OF ENTOMOGENOUS FUNGI FROM PRESERVED DRAGONFLY COLLECTIONS

INTRODUCTION

Several reports of fungal infestation of insects have been brought out by many workers. In India, however, comparatively much less work has been carried out on this phase of study. The most noteworthy and informative reports on *fungi entomogeni* have been produced by Kamat *et al.* (1952), Jagtap (1958) and Narasimhan (1970) who have reported fungi from various groups of insects, such as, Aphids, Termites, Mosquitoes, House flies, Grasshoppers, Butterflies, Honey bees, Cockroaches, Ants, Scale insects, Beetles etc. A review of the above literature clearly indicates that no attenion has so far been given on the dragonflies being infested by fungi, and the sole exception are the papers of Pacioni (1977) and Tyagi and Vijay Veer (1978). The latter workers, in their general study of the entomogenous fungi attacking preserved dragonfly collections, also, discussed the various precautionary and control methods on such fungi.

The present note is the second report on the *fungi entomogeni* infesting the preserved dragonfly material, which also marks the end of our current investigations in this field.

OBSERVATIONS

In the present investigation were used some nine dragonfly species from which the following fungus material was recorded, altogether for the first time. The dragonfly material examined for the purpose are as follows, *Copera marginipes, Pseudagrion rubriceps, Ceriagrion coromandelianum, Ischnura forcipata, Rhinocypha quadrimaculata, Anisopleura lestoides, Brachythemis contaminata, Trithemis festiva* and *Trithemis pallidinervis*. Save for the last species, all the dragonfly material were male. The fungus species discovered on these dragonflies are, *Alternaria* sp., *Aspergillus flavus, Aspergillus nidulans, Coelomomyces* sp., *Entomophthora aphidis, Spicaria javanica,* and *Stemphylium* sp. Considering the entire amount of *fungi entomogeni* thus far known to the world, it seems worth mentioning here that no *Spicaria* sp. has ever been discovered from any insect previously and, therefore, its first record is only from a dragonfly.

Summing up our knowledge on the preponderence of all the fungus species hitherto known to occur or attack dragonflies, whether dead, preserved or alive, it soon becomes evident that *Entomophthora* spp. are the most common fungi to infest their present hosts among which, also, the former has a good dispersal range. Generally, a single fungus species may be found on many different dragonflies while, at the same time, several species of fungi are apt to be obtained from the same individual belonging to any dragonfly species. This conclusion suggests that these fungi are not specific to any particular dragonfly host and can be found attacking any part of the dragonfly body.

This opinion regarding the general abundance of more than one fungus species on a solitary dragonfly host is in contrast to our previous view as mentioned in the former report (cf. Tyagi & Vijay Veer 1978), and which has now become certain as to the nonspecificity of these fungi with respect to their host under discussion and that even several fungi can simultaneously infest one and the same insect, and vice versa.

ACKNOWLEDGEMENTS

We are grateful to Dr. S. K. Sangal and Dr. S. K. Kulshrestha (both of the Department of Zoology, D.A.V. College, Dehra Dun) for encouragement; to Dr. M. B. Lal (Head of the Department of Zoology, D.A.V. College, Dehra Dun) for laboratory facilities; and to Mr. S. N. Sachan (Botany Department, D.A.V. College, Dehra Dun) for kindly identifying the fungus species.

DEPARTMENT OF ZOOLOGY,
D.V.A. (P.G.) COLLEGE,
DEHRADUN-248 001, U.P.,
December 29, 1978.

BRIJ KISHORE TYAGI
VIJAY VEER

REFERENCES

JAGTAP, A. P. (1958): Studies in the entomogenous fungus, *Metarrhizium anisophae* (Metsch.) Sorok. *Curr. Sci. 27*: 99-100.

KAMAT, M. N., PATEL, M. K. AND DHANDE, G. W. (1952): Occurrence of the green muscardine fungus on *Pyrilla* sp. in Bombay. *Curr. Sci. 21*: 317.

NARASINHAN, M. J. (1970): Entomogenous fungi and possibility of their use for biological control of insect pests in India. *Indian Phytopath. 23*: 16-26.

PACIONI, G. (1977): Interessanti fungi entomogeni italiani: I *Paecilomyces fumosa-rosens, Cordyceps memorabilis. Giornala Botanica Haliano 111* (3): 145-151.

TYAGI, B. K. AND VEER, VIJAY (1978): A note on some entomogenous fungi attacking the preserved dragonfly collections. *J. Bombay nat. Hist. Soc. 75* (3): 946-947.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1977-78

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HONORARY SECRETARY'S REPORT FOR THE YEAR 1977

The report covers the activities of the Society in the 94th year of its existence.

MEMBERSHIP

During the year 161 new members were enrolled. Unfortunately the total number of ordinary members continues to be more or less static in the region of 700-800. There has been an increase of interest of members in the Society's activities and we hope to reduce the number of members lost every year. Drop outs were 100 and resignations 32 during the year under review. The number of members in each class of membership is given below:

	1974	1975	1976	1977		1978
Ordinary Members	770	763	719	702	Individual 561) Corporate 160)	721
Life Members	198	232	247	247	Individual 246) Corporate 13)	259
Student Members	16	20	19	20		39
Honorary Members	4	4	4	4		4
Forest Dept. Nominees	90	90	90	36	—	—

PUBLICATIONS

The Journal continues to be delayed in its publication. Three issues were published during the year, two of them (Vol. 73 No. 2 and Vol. 73 No. 3) being issues of the Journal for the previous year, and only one issue (Vol. 74 No. 1) relates to the current year. It has been possible, with the increased page space available in the new format to reduce the number of pending articles.

The articles continued to cover a wide range of subjects with emphasis on the ecology, behaviour, and taxonomy of Indian Fauna and the taxonomy and regional lists of Indian Flora.

The Society's illustrated newsletter-cum-popular Journal, the *Hornbill* has had a successful year and has served the purpose of creating and retaining member interest in the Society and in attracting new members. Four issues of the *Hornbill* were published during the year.

Books:

During the year the following sales were made:

	Sale	Balance stock 31 December 1977
Book of Indian Birds	2894	5106
Book of Indian Animals	479	61
India's Wildlife in 1959-70	319	161
Some Beautiful Indian Trees	235	2765
Glimpses of Nature in India Booklet	267	2774
Checklist of the Birds of Maharashtra	58	466

The following books were published:

BOOK OF INDIAN BIRDS by Sálim Ali, 10th edition. This edition received excellent support from members and others and nearly one third of the copies printed were sold.

SOME BEAUTIFUL INDIAN TREES by Blatter and Millard, 3rd edition. We are grateful to the Department of Science and Technology, Government of India for the financial assistance which made this publication possible.

INDIA'S WILDLIFE 1959-70 by M. Krishnan. Based on Mr. M. Krishnan's survey of the wildlife in India during 1970 under a Jawaharlal Nehru Fellowship. The publication of this book was made possible by the generous financial assistance of the Seth Purshottamdas Thakoredas and Divalibai Charitable Trust.

Books under preparation:

We have in the press the second edition of A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN by Dillon Ripley and the second edition of SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS, by Bor and Raizada. The former is financed by the author and the latter from funds made available by the Department of Science and Technology, Government of India.

Also under preparation are the 4th edition of THE BOOK OF INDIAN ANIMALS and the first edition of the GRASSES OF WESTERN INDIA by T. Hodd. The work on the Centenary Publication, ENCYCLOPEDIA OF INDIAN NATURAL HISTORY with Mr. R. E. Hawkins as general editor, is in progress. This publication is also being financed by the Department of Science and Technology, Government of India.

CONSERVATION

The Society continued to take an active part in the Conservation Movement in the country through its association with State and Central Wildlife Boards, and through its members on the International Union for Conservation of Nature and Natural Resources, the World Wildlife Fund, and the International Council for Bird Preservation.

The Society's Curator has been nominated as the Co-Chairman of the SSC's Asian Elephant Specialist Group. The regional meeting of the group was arranged at Bangalore at the Indian Institute of Science, when the programme of work and regional task forces to undertake surveys were organised.

MEMBERS' ACTIVITIES

It has been possible to interest and encourage members in Bombay and elsewhere in field activities.

Bird Count: A monthly roadside count of birds in the Borivli National Park was organised with the assistance of members. The activity received financial assistance from the Sálim Ali/Loke Ornithological Research Fund. The activity is being continued.

Nature Walks: Nature walks were organised in Borivli National Park and elsewhere for bird-watching, vegetation studies and general natural history. A large number of members participated.

Nature Camp: A camp was organised in October at Bandipur National Park and the Tahr country in the Nilgiris. 41 members participated in two groups led by Dr. Robert B. Grubh, Dr. Reza Khan and Mr. P. B. Shekar.

RESEARCH

Bird banding data: Computer analysis of the data has been arranged in collaboration with the Tata Institute of Fundamental Research; feeding of data has commenced.

University Department: Mr. M. A. Reza Khan was awarded the Ph.D. Degree in Field Ornithology of the Bombay University for his thesis on the ecology of the Black-and-Orange Flycatcher in South India. Mr. M. K. Chandrahas was awarded M.Sc. degree for his thesis on the Ecology of the Five-striped Palm Squirrel.

Nilgiri Bird Survey: On behalf of the Government of Tamil Nadu two field trips to the Nilgiri district were made by the Society's staff and the report on the birds of the district has been sent to the Government.

Bharatpur Bird Sanctuary: The Maharaja of Bharatpur has very generously donated the Kadam Kunj rest house in the Sanctuary to the Society. It is proposed to establish a hydro-biological station in collaboration with the WWF (India) to monitor the ecology of the Sanctuary on a continuing basis.

Ecology of the Honeyguide: Studies were made by Dr. Sálim Ali assisted by Mr. S. A. Hussain. Both of them made visits to Bhutan for preliminary investigation of Honeyguide locations. An ad hoc grant of Rs. 5000/- was made by the Govt. of Bhutan, towards expenses of the study.

ICAR Frog Project: The project with Mr. Humayun Abdulali, as Principal Investigator is programmed to examine the effect produced on agricultural ecology by the removal of frogs for the export of froglegs.

DONATIONS

	Rs.
For Sálim Ali Nature Conservation Fund	
Dr. Sálim Ali	3,51,000.00
Mr. E. W. Mudge Jr.	879.57
For Charles McCann Fieldwork Fund	
Mr. S. Choudhury	600.00
Mr. H. Abdulali	175.00
For Sálim Ali-Loke Wan Tho Ornithological Research Fund	
Dr. Sálim Ali	1000.00
For Hornbill Newsletter	
Dr. Dasgupta	100.00
Mr. Dilip Patil	50.00
Dr. Scaver A. Ballard	56.00
Mr. H. K. Divekar	101.00

MEETINGS

January, 27: *Talk*: 'Biological clocks and seasonal breeding cycles in Animals' by Prof. B. K. Follet.

February, 1: *Talk*: 'Scientific expeditions connected with Zoology and Marine Biology' by Dr. Ferdinand Starmuehlner.

March, 19: *Talk*: 'Introduction to Bird Watching' by Mr. S. A. Hussain.

May, 21: *Talk*: 'Introduction to Bird Watching' by Dr. Robert B. Grubh.

May, 16: *Film show*: 'The Last Stronghold'.

May, 27: *Film show*: 'Snakes of India'.

June, 29: *Talk*: 'Indian Flowering Trees' by Prof. P. V. Bole.

July, 16: *Talk*: 'Introduction to Bird Watching' by Dr. Robert B. Grubh.

September, 17: *Talk*: 'Identification of Waders' by Dr. Robert B. Grubh.

October, 19: *Film show*: 'Antarctic' by Miss Meher Moos.

November, 24: *Talk*: 'Wildlife of the Nilgiris' by Mr. Reza Khan.

November, 29: *Talk*: 'Environment' by Dr. R. M. Naik.

November, 30: *Slide show*: 'Ladakh' and other subjects by Mr. Prakash Gole.

December, 16: *Talk*: 'Another trip to the Andamans and Nicobar' by Mr. Humayun Abdulali.

December, 20: *Talk*: Bhutan: 'In search of the Honeyguide' by Mr. S. A. Hussain.

REFERENCE COLLECTION

During the year 273 specimens were received at the Society:

Mammals	3
Birds	149
Reptiles	56
Amphibians	65
Total	273

Important additions are:

Birds: *Ninox affinis, Micropygia rufipennis*—Coll: H. Abdulali. New subspecies from the Car Nicobar 1976 collection are being described.

Phodilus badius ripleyi—Coll: Reza Khan & V. S. Vijayan.

Amphibians: *Philautus glandulosus*—Coll: J. C. Daniel.

Philautus chalazodus—Coll: J. C. Daniel.

NATURE EDUCATION SCHEME

More than 400 schools were contacted from time to time through circulars. 32 field trips were arranged to Borivli National Park including one for a blind school.

A nature camp was arranged for Municipal Secondary School children. Students from 18 schools were taken to the Prince of Wales Museum, 9 to taraporewala Aquarium and 12 to Jijamata Udyan (Victoria Gardans).

Guidance was given to schools in the preparation of projects on different aspects of nature. 40 schools were visited personally. In addition 5 radio talks on Nature Education were given during the year. Slide shows were arranged in 5 schools.

During the wildlife week an xhibition of 'Our Wildlife' was arranged for school children. 5862 students from 46 schools visited the exhibition.

LIBRARY

During the year 1977 thirty eight (38) books were added to the Society's Library. Of these:

18	were presented
8	purchased
12	received for review
Total 38	

Revenue and Accounts

The financial situation of the Society continued to be unsatisfactory. The year's operation showed a small surplus.

Staff

The Committee wishes to record its appreciation of the willing co-operation of the staff in the activities of the Society.

Acknowledgement

The Committee wishes to record its appreciation for the assistance received from members towards the activities of the Society.

REGISTERED NO. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY
THE BOMBAY PUBLIC TRUST ACT, 1950
Schedule VIII [vide Rule 17(1)]

BALANCE SHEET FOR THE YEAR ENDED 31 *DECEMBER* 1977

FUNDS AND LIABILITIES		
Trust Funds and Corpus:		
Life Membership Fund:		
Balance as per last Balance Sheet	1,01,834.03	
Add: Amount received during the year	10,714.00	1,12,548.03
Fixed Assets Fund:		
Balance as per last Balance Sheet	84,563.94	
Add: Value of the fixed assets purchased during the year	1,022.00	
	85,585.94	
Less: Written off the cost of 2 Jeeps Transferred to American Embassy	8,964.97	
	76,620.97	
Less: Transferred from Income & Expenditure account on account of depreciation for the year	11,147.77	65,473.20
General Reserve Fund:		
Balance as per last Balance Sheet	34,015.40	
Add: Amount transferred from other funds as per details in Schedule 'A'	1,332.36	
Add: Amount transferred from unpaid royalties account	2,604.95	37,952.71
Building Fund:		
Balance as per last Balance Sheet		9,244.68
Carried over		2,25,218.62

ASSETS		
Immovable Properties:		Nil
Investments: (At Appropriated Value)		
50, 8% Convertible Bonds each of Rs. 100/- of Ahmedabad Manufacturing & Calico Printing Co. Ltd. fully paid (market value Rs. 3,500/-)	2,130.20	
202, 8% Redeemable Bonds each of Rs. 116/- of Ahmedabad Manufacturing & Calico Printing Co. Ltd. fully paid (market value Rs. 16,362/-)	9,982.95	
Government Securities: (At cost)		
3% Conversion Loan 1946/86 of the face value of Rs. 25,000/- (Market value Rs. 15,000/-)	25,000.00	
5½% Government of India Loan 2,000 of the face value of Rs. 2,000/- (Market value Rs. 1,802/-)	2,000.00	39,113.15
Motor Cars, Motor Cycle, Auto Cycle:		
Balance as per last Balance Sheet	23,488.26	
Less: Cost of 2 Jeeps transferred to American Embassy written off	8,964.97	
	14,523.29	
Less: Depreciation during the year	2,904.64	11,618.65
Furniture, Fixture and Equipment:		
Balance as per last Balance Sheet	64,923.06	
Carried over	64,923.06	50,731.80

FUNDS AND LIABILITIES		
Brought over		2,25,218.62
Publication Fund:		
Balance as per last Balance Sheet	36,642.25	
Add: Sale proceeds of Glimpses of Nature Booklets published under WWF/Volkart Foundation grant	1,731.50	
Add: Amount spent on Some Beautiful Indian Trees publication received from Government of India capitalised	40,000.00	
Add: Unspent grant for publication transferred as per Schedule 'A'	4,176.78	82,550.53
Other Earmarked Funds:		
(As per Schedule 'A')		8,42,739.46
Provision for Capital Losses:		
Balance as per last Balance Sheet		4,528.38
Provision for Depreciation on Investments:		
Balance as per last Balance Sheet		9,266.10
Liabilities:		
For expenses	1,26,196.31	
For Advance Subscriptions	3,679.58	
For Sunday Credit Balances	25,678.03	1,55,553.92
Carried over		13,19,857.01

ASSETS		
Brought over		50,731.80
Furniture, Fixture and Equipment: (Contd.)	64,923.06	
Add: Additions during the year	1,022.00	
	65,945.06	
Less: Depreciation during the year	8,243.13	57,701.93
Loans: (Unsecured considered good)		
To employees		395.00
Advances: (Unsecured considered good)		
To employees	1,877.88	
,, Others	3,861.37	5,739.25
Stocks: Publications (as per inventory taken and certified by the Curator)		1,19,157.92
Income Outstanding:		
Interest accrued	17,558.64	
Supplies and Services	68,398.90	
Grants Government of India	1,20,000.00	
Grant Government of Maharashtra	77,908.00	
Grant Indian National Science Academy	3,000.00	2,86,865.54
Cash and Bank Balance:		
A) *In current account with*:		
1. Grindlays Bank Ltd., Mahatma Gandhi Road, Bombay	26,067.22	
2. Grindlays Bank Ltd., London (£ 1560/90) converted at Rs. 15.60 = £ 1)	24,350.04	
3. Chartered Bank, Bombay	9,885.07	
In Savings Account with:		
1. Grindlays Bank Ltd., Mahatma Gandhi Road, Bombay	14,274.57	
2. Bank of India, Museum Savings Branch, Bombay	18,481.86	
Carried over	93,058.76	5,20,591.44

FUNDS AND LIABILITIES		ASSETS		
Brought over	13,19,857.01	Brought over		5,20,591.44
		Cash and Bank Balances: (Contd.)	93,058.76	
		B) *In Fixed Deposit with*:		
		1. Bank of India, Bombay (consisting of Rs. 36,000/- of Dr. Sálim Ali/ Loke Wantho Ornitholigical Research Fund and Rs. 3,000/- for Col. Burtons Nature Conservation Fund	39,000.00	
		2. Chartered Bank, Bombay including Rs. 19,000/- of Charles McCann Vertebrate Zoology field work fund and Rs. 20,000/- of Pirojsha Godrej Foundation fund	42,400.00	
		3. Grindlays Bank, Bombay including Rs. 59,000/- of Dr. Sálim Ali-Loke Wantho Ornithological Research Fund	95,000.00	
		C) *In Monthly income certificates with*: Bank of India, Bombay consisting of Rs. 1,25,000/- of Dr. Sálim Ali-Loke Wanto Ornithological Research Fund, and Rs. 3,50,000/- of Dr. Sálim Ali Nature Conservation Fund	4,75,000.00	7,44,458.76
		Income and Expenditure Account:		
		Balance as per last Balance Sheet	61,973.16	
		Less: Excess of income over expenditure as per Income & Expenditure Account	7,166.35	54,806.81
TOTAL	13,19,857.01	TOTAL		13,19,857.01

Sd/- Salim Ali,
President,
Bombay Natural History Society.

Sd/- A. N. D. Nanavati,
Honorary Secretary,
Bombay Natural History Society.

Sd/- C. V. Kulkarni,
Honorary Treasurer,
Bombay Natural History Society.

As per our report of even date

Sd/- Habib & Co.,
Chartered Accountants.

Bombay, *25th October, 1978.*

SCHEDULE 'A'

BOMBAY NATURAL HISTORY SOCIETY
SCHEDULE FORMING THE PART OF BALANCE SHEET AS AT 31 DECEMBER, 1977

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ Refunded* during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1977 (5 minus 8)* (9)
(1) Field work fund (Sir Dorabjee Tata Trust)	2,169.14	—	—	2,169.14	—	—	—	2,169.14
(2) Staff Welfare Fund	2,020.69	623.64	—	2,644.33	400.00	—	400.00	2,244.33
(3) Dr. Sálim Ali-Loke Wantho Ornithological Research Fund	2,20,136.52	1,000.00	—	2,21,136.52	—	—	—	2,21,136.52
(4) Col. Burton's Nature Conservation Fund	3,875.34	300.00 (Interest)	—	4,175.34	—	—	—	4,175.34
(5) Charles McCann Vertebrate Zoology Field Work Fund	19,865.94	2,807.00 (Including interest Rs. 1900/-)	—	22,672.94	—	—	—	22,672.94
(6) Grant Seth Purushottamdas Thakoredas Divaliba Charitable Trust for the publication of Shri M. Krishnan's book of India's Wildlife	5,829.29	—	—	5,829.29	4,677.09	1,152.20*	5,829.29	—
(7) Grant from His Majesty King of Bhutan for the publication of 'Birds of Bhutan' by Dr. Sálim Ali	5,813.39	—	—	5,813.39	3,200.00	2,613.39	5,813.39	—
(8) Grant from World Wildlife Fund for the Publication of a booklet on Conservation	3,024.58	—	—	3,024.58	—	3,024.58	3,024.58	—
Carried over	2,62,734.89	4,730.64	—	2,67,465.53	8,277.09	6,790.17	15,067.26	2,52,398.27

Name of the Fund/Grant (1)	Balance as per last Balance Sheet (2)	Additions/ Amounts received during the year (3)	Transfers from other Funds (4)	Total of columns 2, 3, & 4 (5)	Spent/ Refunded* during the year (6)	Transfers to other Funds (7)	Total of columns 6 & 7 (8)	Balance as at 31st December 1977 (5 minus 8) (9)
Brought over	2,62,734.89	4,730.64	—	2,67,465.53	8,277.09	6,790.17	15,067.26	2,52,398.27
(9) Scholarship fund under Dr. Sálim Ali/Loke Wantho Ornithological Research Fund investments	6,457.21	22,940.02 (Interest)	—	29,397.23	24,942.41	—	24,942.41	4,454.82
(10) Grant Govt. of India, Department of Science & Technology, for Plan expenditure for 1975-76, contd. 1976-77, contd. 77-78	44,969.30	—	—	44,969.30	7,145.70	—	7,145.70	37,823.60
(11) Grant Govt. of India, Dept. of Science & Technology for the backlog of Journal Ptg. expenses 1976-77, contd. 77-78	21,180.00	—	—	21,180.00	5,476.50	—	5,476.50	15,703.50
(12) Grant Govt. of India, Dept. of Science & Technology for Encyclopedia of Natural History 76-77, contd. 77-78	22,000.00	—	—	22,000.00	174.62	—	174.62	21,825.38
(13) Grant Govt. of India, Dept. of Science & Technology for steel cabinets 1977-78	—	60,000.00	—	60,000.00	—	—	—	60,000.00
(14) Grant Govt. of India, Dept. of Science & Technology for Publication 1977-78	—	40,000.00	—	40,000.00	2,869.86	—	2,869.86	37,130.14
(15) Grant from Bodega Bay Institute of Pollution Ecology for DDT Pollution	1,332.36	—	—	1,332.36*	—	1,332.36	1,332.36	—
(16) Director of Archives, Tamil Nadu for Pudukkottai Bird Survey	15.30	—	—	15.30	15.30	—	15.30	—
Carried over	3,58,689.06	1,27,670.66	—	4,86,359.72	48,901.48	8,122.53	57,024.01	4,29,335.71

Name of the Fund/Grant (1)	Balance as per last Balance Sheet (2)	Additions/ Amounts received during the year (3)	Transfers from other Funds (4)	Total of columns 2, 3, & 4 (5)	Spent/ Refunded* during the year (6)	Transfers to other Funds (7)	Total of columns 6 & 7 (8)	Balance as at 31st December 1977 (5 *minus* 8) (9)
Brought over	3,58,689.06	1,27,670.66	—	4,86,359.72	48,901.48	8,122.53	57,024.01	4,29,335.71
(17) Commissioner of Archives & Historical Research, Tamil Nadu for Nilgiri District Gazetteer Survey of Avifauna	5,000.00	—	—	5,000.00	5,000.00	—	5,000.00	—
(18) Indian Space Research Organisation, Sriharikota for Bird Survey	2,227.00	248.22	—	2,475.22	2,475.22	—	2,475.22	—
(19) The Projsha Godrej Foundation Fund	20,000.00	—	—	20,000.00	—	—	—	20,000.00
(20) Grant Indian Council of Agricultural Research for determination of Ecological Disturbances in agricultural and adjoining lands caused by removal of *Rana hexadactyla* for export	6,916.48	16,580.00	—	23,496.48	22,294.72	—	22,294.72	1,201.76
(21) Field work fund under Pirojsha Godrej Foundation fund investment	616.66	2,000.00 (Interest)	—	2,616.66	—	—	—	2,616.66
(22) Projector Fund received from members	3,250.00	—	—	3,250.00	1,022.00	—	1,022.00	2,228.00
(23) Grant Govt. of Bhutan for Birds of Bhutan Survey	—	5,000.00	—	5,000.00	5,000.00	—	5,000.00	—
(24) Dr. Sálim Ali Conservation Fund	—	3,51,857.59	—	3,51,857.59	—	—	—	3,51,857.59
(25) Conservation Fund under Dr. Sálim Ali Conservation Fund Investment	—	33,249.92 (Interest)	—	33,249.92	20,723.29	—	20,723.29	12.526.63
(26) IUCN/WWF, Elephant Survey Grant	—	13,141.00	—	13,141.00	11,604.38	—	11,604.38	1,536.62
Carried over	3,96,699.20	5,49,747.39	—	9,46,446.59	1,17,021.09	8,122.53	1,25,143.62	8,21,302.97

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ Refunded* during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1977 (5minus 8)* (9)
Brought over	3,96,699.20	5,49,747.39	—	9,46,446.59	1,17,021.09	8,122.53	1,25,143.62	8,21,302.97
Grants from Government of Maharashtra:								
(1) *Grant for* 1976-77: For establishment & Building maintenance	15,680.36	—	—	15,680.36	15,680.36	—	15,680.36	—
(2) *Grant for* 1977-78: For establishment & Building maintenance	—	73,908.00	—	73,908.00	52,471.51	—	52,471.51	21,436.49
* Grant Govt. of India, Dept. of Science & Technology for Publication	35,639.26	—	—	35,639.26	35,639.26	—	35,639.26	—
TOTAL	4,48,018.82	6,23,655.39	—	10,71,674.21	2,20,812.22	8,122.53	2,28,934.75	8,42,739.46

* Transferred to General Reserve Fund.

Sd/- HABIB & Co.,
Chartered Accountants.

BOMBAY, *25th October, 1978.*

Registered No. F-244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY
THE BOMBAY PUBLIC TRUST ACT, 1950
SCHDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER, 1977

EXPENDITURE		
To *Expenses in respect of Properties*:		
Rates, taxes and cesses	Nil	
Repairs and maintenance	3,478.91	
Salaries	—	
Depreciation (By way of provision or adjusted	—	3,478.91
,, *Building Maintenance Expenses*:		
(As per Contra)		
Met out of the Maharashtra Govt. grant		
for 1976-77	340.08	
for 1977-78	8,000.00	8,340.08
,, *Establishment Expenses*:		
Salaries including D.A. etc. from Government of Maharashtra (as per contra)		
For 1976-77	15,340.28	
For 1977-78	44,471.51	
Salaries including D.A. etc. (other than above)	91,937.93	
Carried over	1,51,749.72	11,818.99

INCOME			
By *Rent* (Accrued and realised)			Nil
,, *Interest* (Accrued & Realised)			
On Securities	3,134.56		
Less: Income tax deducted at source	523.00	2,611.56	
On fixed deposits	65,165.80		
Less: Income tax deducated at source	1,661.00	63,504.80	
Add: Refund of Income tax for the year 1973, 1974 & 1975		5,135.00	71,251.36
,, *Donations*:			
In Cash		2,339.80	2,339.80
,, *Towards Specific Funds*			
Charles McCann Vertebrate Zoology Field work fund		775.00	
Staff Welfare fund		623.64	
Sálim Ali-Loke Wantho Ornithological Research Fund		1,000.00	
Sálim Ali Nature Conservation Fund		3,51,857.59	3,54,256.23
Carried over			4,27,847.39

EXPENDITURE		
Brought over		11,818.99
To *Establishment Expenses* Contd.	1,51,749.72	
Society's contribution to staff Provident Fund	5,703.00	
Payment for ex-gratia payment to retired employees	2,732.00	
Postages	3,650.65	
Printing & Stationery	4,946.27	
Advertisement	95.00	
Bank charges	800.13	
Telephone charges	3,390.90	
Meeting expenses including talks, film shows etc.	1,770.65	
Conveyance & Travelling Expenses (Local)	657.90	
Motor car, Motor repairs and maintenance expenses	4,152.83	1,79,649.05
„ *Audit Fees*:		1,000.00
„ *Amounts Written off*:		
(a) Bad debts	5,232.63	
(b) Loan Scholarships	—	
(c) Irrecoverable rent	—	5,232.63
„ *Miscellaneous Expenses*:		
General charges	3,052.74	
Insurance premium	209.00	
Repairs to furniture & equipment	1,170.04	
Legal & Professional fees	2,750.00	7,181.78
„ *Depreciation*:		
On furniture and equipment	8,243.13	
On Motor cars, Motor Cycle & Auto cycle	2,904.64	11,147.77
Carried over		2,16,030.22

INCOME		
Brought over		4,27,847.39
„ *Grants*:		
(a) *Government of Maharashtra*:		
1. for 1977-78 Establishment & Building maintenance expenses	73,908.00	
2. for 1977-78 Education Activity	4,000.00	
(b) *Government of India*:		
Department of Science & Technology		
1. For 1977-78 Journal printing expenses	20,000.00	
2. For 1977-78 Publications	40,000.00	
3. For 1977-78 Steel cabinets etc.	60,000.00	
(c) Indian National Science Academy for 1977-78 Journal Printing Expenses	3,000.00	
(d) Indian Space Research Organisation for Bird Survey in Sriharikotta	248.22	
(e) Indian Council of Agricultural Research for 1977-78 Frog Project	16,580.00	
(f) Grant Government of Bhutan for Bird Survey in Bhutan	5,000.00	
(g) Grant IUCN/WWF for Elephant survey	13,141.00	2,35,877.22
„ *Income from Subscription & Entrance Fees*:		
Membership subscriptions	35,179.58	
Student Membership subscriptions	600.00	
Corporate Membership subscriptions	18,063.17	
Subscription to Journal (Non members)	15,149.98	
Entrance fees	4,720.00	73,712.73
„ *Income from Publications*:		
Journal Sales	1,929.00	
Glimpses of Nature Booklets	1,731.50	
Checklist of the Birds of Maharashtra	132.00	3,792.50
Carried over		7,41,229.84

EXPENDITURE		
Brought over		2,16,030.22
,, *Amount Transferred to Reserve or Specific Funds*:		
Grant transferred to relevant funds	2,08,877.22	
Donations towards specific funds transferred to relevant accounts in the Balance Sheet	3,54,256.23	
Sale proceeds transferred to Publication fund account (Glimpses of Nature Booklets)	1,731.50	
Sale proceeds transferred to Charles McCann Vertebrate Zoology field work fund (check-list of the Birds of Maharashtra)	132.00	
Interest on Fixed Deposits Transferred to Respective Funds	60,389.94	6,25,386.89
To *Expenses on Objects of the Trust*:		
Educational:		
from respective funds (as per contra)		
(1) Expenses towards research scholarship & other expenses on Ornithological research out of scholarship fund under Dr. Sálim Ali-Loke Wantho Ornithological Research Fund Investment	24,942.41	
(2) Expenses on publication of Shri M. Krishnan's book on India's Wild Life out of grant from Seth Purushottamdas Thakoredass & Divaliba Charitable Trust)	4,677.09	
Carried over	29,619.50	8,41,417.11

INCOME		
Brought over		7,41,229.84
Surplus on sale of books:		
Book of Indian Birds	39,297.53	
Book of Indian Animals	10,031.52	
Some Beautiful Indian Trees	2,818.26	
India's Wildlife in 1959-70	9,526.75	
Identification of poisonous snake charts	445.00	
Other Publications	3,110.40	
Nature Calendars	18,097.05	
	83,326.51	
Add: Profit on packing charges	42.91	83,369.42
Miscellaneous Income:		
Library fines	33.30	
Fees for the use of Society's transparencies	1,400.00	
Other receipts	2,450.39	
Profit on exchange of sterling A/c.	378.92	4,262.61
By *Administrative Fees*:		
for handling various project funds during the year debited to respective funds		6,503.08
,, *Transfers*: (to specific funds)		
Depreciation of fixed assets transferred to fixed assets fund (as per contra)	11,147.77	
Expenditure on Establishment & Bldg. maintenance transferred to Govt. of Maharashtra Grant (as per contra)	68,151.87	
Expenditure on specific objects transferred to relevant funds (as per contra)	1,51,638.35	
Carried over	2,30,937.99	8,35,364.95

EXPENDITURE		
Brought over		8,41,417.11
To Expenses on Objects of the Trust: (Contd.)	29,619.50	
(3) Expenses on field staff salaries & other expenses relating to Bird data analysing study out of grant Govt. of India, Dept. of Science & Technology for Plan expenditure	7,145.70	
(4) Expenses on Publication out of grant Govt. of India, Dept. of Science & Technology 1976-77	35.639.26	
(5) Expenses on publication out of grant Govt. of India, Dept. of Science & Technology 1977-78	2.869.86	
(6) Expenses on Indexes on Back issues of Journal printing met out of Grant Govt. of India, Department of Science & Technology 1976-77	5,476.50	
(7) Expenses on Frog project met out of grant from Indian Council of Agricultural Research	22.294.72	
(8) Expenses on Nilgiri District Gazetteer Survey met out of grant Government of Tamil Nadu	5,000.00	
(9) Expenses on Bird Survey met out of grant from Indian Space Research Organisation in Sriharikotta	2,475.22	
Carried over	1,10,520.76	8,41,417.11

INCOME		
Brought over		8,35,364.95
By Transfers: (Contd.)	2,30,937.99	
„ *Transferred from Reserve or Specific Funds*: Amount of interest earned on the grant H.H. King of Bhutan for the publication of Birds of Bhutan by Dr Sálim Ali	2,613.39	2,33,551.38
Carried over		10,68,916.33

EXPENDITURE					INCOME	
Brought over				8,41,417.11	Brought over	10,68,916.33
To Expenses on Objects of the Trust: (as per contra) (Contd.)			1,10,520.76			
(10) Expenses on:						
(a) Bhutan Bird Survey		3,286.91				
(b) Mysore Bird Survey trip		697.18				
(c) Printing of Hornbill News-letter total cost	22,297.20					
Less: Advertisement	5,558.00	16,739.20	20,723.29			
(11) Expenses on Bhutan Bird Survey out of Grant from Govt. of Bhutan			5,000.00			
(12) Expenses on IUCN/WWF Elephant Survey met out of grant from IUCN/WWF			11,604.38			
(13) Paid to employees out of staff Welfare fund			400.00			
(14) Expenses on Encyclopedia of Natural History out of grant Govt. of India, Department of Science & Technology 1976-77			174.62			
(15) Expenses on Birds of Bhutan by Dr. Sálim Ali out of grant from H.H. King of Bhutan			3,200.00			
			1,51,623.05	8,41,417.11		10,68,916.33

EXPENDITURE			INCOME	
Brought over		8,41,417.11	Brought over	10,68,916.33
To Expenses on Objects of the Trust: (Contd.)	1,51,623.05			
(16) Expenses on Pudukkottai survey out of the funds from Commissioner of Archites & Historical Research, Tamil Nadu	15.30			
(B) Journal expenses	60,117.73			
(C) Field study programmes and other field study trips	3,371.99			
(D) *Library Account*:				
Subscriptions to other societies	2,878.29			
Purchase of new books	72.75			
Other Library expenses	49.45			
(E) *Maintenance of Reference Collection*:	2,204.31	2,20,332.87		
Excess of Income over expenditure transferred to Balance Sheet		7,166.35		
Total		10,68,916.33	Total	10,68,916.33

Sd/- SALIM ALI,
President.

Sd/- A. N. D. NANAVATI,
Honorary Secretary.

Sd/- C. V. KULKARNI,
Honorary Treasurer.

As per our report of even date
Sd/- HABIB & CO.,
Chartered Accountants.

BOMBAY, *25th October, 1978.*

BOMBAY NATURAL HISTORY SOCIETY
NATURE EDUCATION SCHEME
Receipts and ***Payments*** *Account for the year ended 31 December, 1977*

RECEIPTS			PAYMENTS		
To Balance as at 1st January, 1977:			*By* Salary Nature Education Organiser		8,216.10
With Grindlays Bank Ltd., Bombay on Current account	10,288.73		,, Printing and Stationery		274.95
With Bombay Natural History Society, Bombay	79.40		,, General Charges		1,778.63
With Nature Education Organiser	200.00	10,568.13	,, Postages		213.25
Sales of Nature Study Booklets		1,434.25	,, *Balance as at* 31*st December,* 1977:		
			1. With Bombay Natural History Society	13.10	
			2. With Grindlays Bank Ltd., Bombay on Current account	1,306.35	
			3. Cash on hand with Nature Education Organiser	200.00	1,519.45
Total		12,002.38	Total		12,002.38

Sd/- SALIM ALI,
President.

Sd/- A. N. D. NANAVATI,
Honorary Secretary.

Sd/- C. V. KULKARNI,
Honorary Treasurer.

As per our report of even date
Sd/- HABIB & Co.,
Chartered Accountants.

BOMBAY, *25th October, 1978.*

The Annual General Meeting of the Bombay Natural History Society for 1977 was held on Wednesday, the 10th January 1979 at 6.30 p.m. at Hornbill House, Opp. Lion Gate, Shahid Bhagat Singh Road, Bombay, when the following were present:

Mr. Humayun Abdulali
Dr. Sálim Ali
Mr. G. V. Bedekar
Mr. H. K. Divekar
Mr. S. P. Godrej
Mr. D. N. Goenka
Mr. R. E. Hawkins
Mr. J. P. Irani
Dr. A. K. Joshee
Dr. C. V. Kulkarni
Mr. Duleep Matthai
Mr. Bansi Mehta
Mr. C. B. Mehta
Mr. S. N. Mistry
Dr. A. N. D. Nanavati
Mr. Dinsha J. Panday
Mr. V. K. Paralkar
Mr. Dilip Patil
Mr. Ulhas Rane
Mr. A. Rashid
Mr. K. K. Vajifdar
Mrs. D. S. Variava

Dr. Sálim Ali proposed Mr. R. E. Hawkins to the Chair and was seconded by Dr. A. N. D. Nanavati.

The Honorary Secretary's report having been circulated was taken as read, and the members present were asked if they had any queries on the report.

Mr. Humayun Abdulali questioned the wisdom of carrying on with the computerisation of the Bird Banding data. His enquiries in the company of a knowledgeable friend at the Tata Institute of Fundamental Research at the instance of the Society's last AGM revealed that no programme was set, and he was doubtful if any useful purpose would be served by carrying on with the work.

Mr. Hawkins explained that computerisation of some 250,000 records was being carried on for sake of a general study of the data collected during the ten years of bird banding.

Mr. Abdulali enquired about the proposed Hydrobiological Station at Bharatpur and whether a project proposal has been prepared and submitted to the Executive Committee.

The Honorary Secretary stated that a project has been prepared and incorporated in the Society's Five-Year Plan and that further action depends upon the availability of funds.

Mrs. Variava proposed that the Honorary Secretary's report be accepted, and Mr. Bedekar seconded the proposal.

The Honorary Treasurer while dealing with the Balance Sheet and Accounts stated that the Balance Sheet showed a surplus of Rs. 7166.35, reducing our previous deficit from Rs. 61,973.16 to Rs. 54,806.81.

He explained that the suggestions made at the last AGM have been executed as far as they were practicable.

Mr. Bedekar proposed that the Honorary Treasurer's report be accepted and was seconded by Mr. H. K. Divekar.

Mr. Bedekar proposed that the auditors Messrs Habib & Co. be re-appointed on the same terms (*viz.* a fee of Rs. 1000/-) and was seconded by Dr. Kulkarni.

The Chairman expressed the hope that, as the business of the meeting had been completed expeditiously, the next Annual General Meeting would be combined with a lecture or film.

The meeting terminated with a vote of thanks to the Chair.

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater, 4th edition (reprint). 28 plates in colour by Paul Barruel and many other monochrome illustrations. Rs. 60.00
(*Price to members Rs.* 55)

The Ecology of the Lesser Bandicoot Rat in Calcutta, by James Juan Spillett. Rs. 10

Birds

The Book of Indian Birds, by Sálim Ali. 11th (revised) edition. 74 coloured and many monochrome plates. Rs. 60.00
(*Price to members Rs.* 55)

Checklist of the Birds of Maharashtra, by Humayun Abdulali. Rs. 2.50
(*Price to members Rs.* 2)

Checklist of the Birds of Delhi, Agra and Bharatpur, by Humayun Abdulali & J. D. Panday. Rs. 3.00

Snakes

Identification of Poisonous Snakes, Wall chart in Gujarati, and Marathi. Rs. 5

Plants

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 3rd edition (Reprint). Rs. 40.00
(*Price to members Rs.* 35)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. 2nd edition. (*in Press*)

Miscellaneous

Glimpses of Nature Series Booklets:

1. OUR BIRDS I (with 8 coloured plates) in Kannada	Rs. 0.62
2. OUR BEAUTIFUL TREES (with 8 coloured plates) in Hindi	Rs. 0.62
3. OUR MONSOON PLANTS (with 8 coloured plates) in Hindi and Marathi.	Rs. 0.80
4. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, and Hindi	Rs. 1.25

Glimpses of Nature in India (with 40 coloured plates) in English Rs. 7.50
(*Price to members Rs.* 5)

Back numbers of the Society's Journal. Rates on application.

The Society will gratefully accept back numbers of the *Journal*, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Entrance Fees:	
Ordinary and Life Members	Rs. 25
Student Members	Rs. 10
Subscription:	
(*a*) Ordinary individual Members	Rs. 50
(*b*) Ordinary Corporate Members	Rs. 100
(*c*) Ordinary Members resident outside India	Rs. 85
Life Members	Rs. 750 (Rs. 250 after 20 years)
Compound Corporate Members	Rs. 1500
Student Members (without Journal)	Rs. 10
Annual subscription to Journal	Rs. 105

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £ 5.50 should be paid annually to the Society's London Bankers—The Grindlays Bank Ltd., 23 Fenchurch Street, London EC3P. 3ED. Account No. 1101091.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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AUGUST 1980 Rs. 35

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Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names to be printed in italics should be underlined.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 8.20 × 5.60 cm (No. 2 Brownie) and on glossy glazed paper.

6. Text-figures, line drawings, and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name, with the abridged titles of journals or periodicals underlined (italics) and titles of books *not* underlined (roman type), thus:

Banerji, M. L. (1958): Botanical Exploration in East Nepal. *J. Bombay nat. Hist. Soc.* *55*(2):243-268.

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8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Banerji 1958).

9. *Synopsis*: Each scientific paper should be accompanied by a concise, clearly written synopsis, normally not exceeding 200 words.

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11. The editors reserve the right, other things being equal, to publish a member's contribution earlier than a non-member's.

Hornbill House,
Shahid Bhagat Singh Road,
Bombay 400 023.

EDITORS,
Journal of the Bombay Natural History Society.

VOLUME 77 NO. 2: AUGUST 1980

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JOURNAL
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1980 AUGUST Vol. 77 No. 2

CONSERVATION FUTURE OF THE SALTWATER CROCODILE (*CROCODYLUS POROSUS* SCHNEIDER) IN INDIA[1]

H. R. BUSTARD[2] AND B. C. CHOUDHURY[3]

(*With four plates & a text-figure*)

The conservation future of the Saltwater Crocodile in India is discussed together with reasons for the species' decline and conservation programmes already in progress. The Saltwater Crocodile is endangered in India at the present time due to inadequate steps being taken to ensure the long-term survival of its mangrove habitat. Whereas hunting was responsible for the earlier dramatic decline in the species' numbers habitat loss now poses the most serious long-term problem since the species is fully protected by law and effective protection can be provided in the field. Conservation programmes have operated since 1975 in Orissa, and 1976 in West Bengal and Andhra Pradesh, and work commenced in 1979 in the Andamans. However, the Bhitarkanika Sanctuary in Orissa is the only successfully operating sanctuary for the species in India and its integrity is seriously threatened by encroachment. Much of India's coastal mangrove forests have been destroyed and the remnants are rapidly disappearing. Unless sanctuaries to effectively protect the mangroves, as well as the wildlife, can be set up and soundly managed to ensure their long-term integrity, the Saltwater Crocodile will become extinct. It is suggested that well-managed commercial utilisation of this valuable economic species could help to ensure the future of the sanctuary areas and with them the crocodile.

"No country has done more than India to conserve its crocodilian resources and nowhere has the effort met with such marked success" (Bustard, *in press*, a). Concerned about the future of India's crocodilians, particularly the gharial (*Gavialis gangeticus*).

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Government of India asked UNDP for assistance in carrying out a survey. The resultant report (FAO 1974), stated that the Gharial was on the verge of extinction, the saltwater crocodile (*Crocodylus porosus*) reduced to two pockets in its former strong-hold along the Bay of Bengal, and the mugger (*C. palustris*) a fast depleting species.

Following this Report, Government of India initiated a Crocodile Project, with FAO/UNDP assistance, and the senior author, who had carried out the 1974 investigation, became Chief Technical Adviser for the large scale Project which subsequently ensued and is still in progress. (The present project is scheduled to terminate in December 1980.)

An early account of the project development in Orissa, the first State to take up works under the Government of India Project, is given in FAO (1975). The gharial occurs only in the Indian region and its future was the subject of much international concern. The very critical situation facing the gharial (FAO 1974, 1975) led naturally to maximum efforts being directed to that species in the early years. This tended to overshadow the deteriorating status of the saltwater crocodile, and delayed realisation of the seriousness of its poor future conservation status as a member of the Indian fauna, although a project was initiated on this species in Orissa in 1975, and a further project commenced in West Bengal in 1976. Today, the very success of "Project Gharial" tends to hide the urgent steps that need to be taken to assure the future of the saltwater crocodile in India.

As recently as 1971, Neill was able to write of this species. "In spite of its wide range, the estuarine crocodile has not become well known" and,

"The activities of the adult estuarine crocodiles, outside of nesting and of predation on man, are practically unknown."

Since then the species has been the subject of considerable research, particularly in Australia by Messel's group which followed on from Bustard's high-lighting of its conservation predicament in the Australian region (Bustard 1967, 1969 a, b, and c, 1970, and numerous inter-governmental reports) and in India as part of the Government of India Project on Crocodile Breeding and Management (FAO 1974, 1975, Bustard 1978, *in press*, b; Choudhury & Bustard 1980; Kar & Bustard, *in press*). The biology of the species is now sufficiently well known to plan sound conservation management.

GEOGRAPHICAL DISTRIBUTION AND PRESENT STATUS

The saltwater crocodile formerly had an enormous geographical distribution from Cochin in South-west India, eastwards to South China, and extending Southwards through Malaysia, Indonesia and the Philippines to New Guinea and Northern Australia. In India the species had its world Western distributional limits near Cochin and occurred along the Bay of Bengal in the States of Tamil Nadu, Andhra Pradesh, Orissa and West Bengal and the Union Territory of the Andaman and Nicobar Islands (Figure 1).

The species is now extinct on the Asian mainland east of Saigon. Throughout this extensive remaining distributional range the species must now be considered rare to endangered. It is listed as endangered in the RED DATA BOOK of IUCN (1975).

This species was still common in the immediate postwar years before large-scale hunting commenced. However, whole populations were wiped out in a matter of years. In

Papua-New Guinea it had become very rare by the early sixties (Bustard 1967), in Northern Australia by around the mid-sixties with the hunting effort in Western Australia taking place last (Bustard 1970).

India did not escape this large-scale hunting phase (FAO 1974). In 1974 no reliable information existed on the then status of the saltwater crocodile in India. Early writers frequently commented on its abundance. The

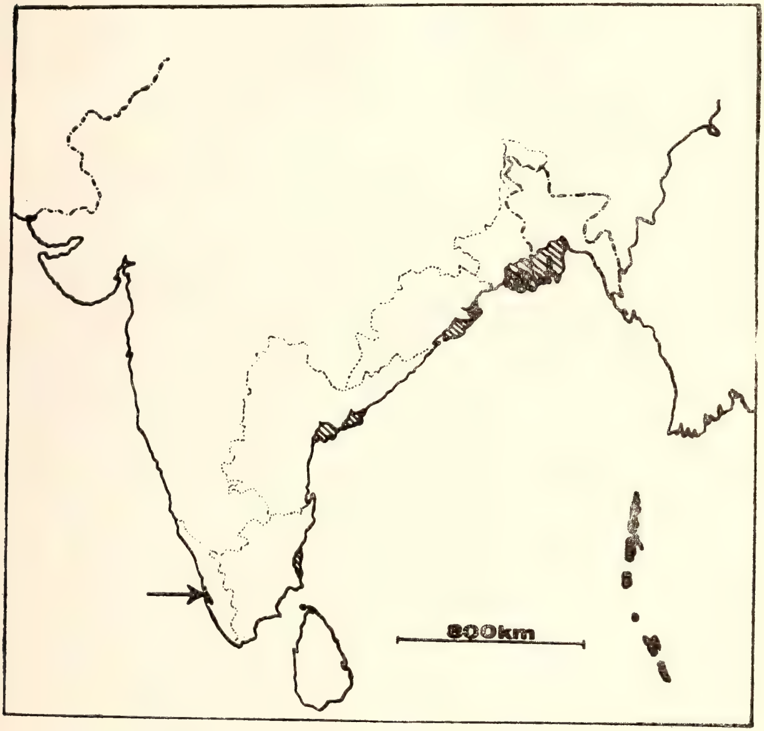


Fig. 1. Distribution of the Saltwater Crocodile in India today. Mangrove areas are indicated by diagonal lines and the occurrence of Saltwater Crocodile by solid black areas. The arrow indicates the location of Cochin, the former Western distributional limit of the species. The scale indicates 800 km.

distinguished herpetologist Günther (1864) wrote, "This is a very common species along all the rivers of the East Indian Continent and Archipelago."

More recently Deraniyagala (1939) noted: "It flourishes along the shores of the Bay of Bengal."

Within the memory of reliable living witnesses this species was abundant in most suitable Indian habitat.

Following a catastrophic decline as a result of indiscriminate hunting in the total absence of controls (Bustard 1978), the saltwater crocodile is now rare or extinct in most of its former Indian habitat. Starting at its Western geographical limits, it is now believed to be extinct in Kerala (where most of the mangrove cover has been lost), extinct in Tamil Nadu (the last individual was shot in 1936, Biddulph 1936), extinct in Andhra Pradesh, [a 3.2 m individual was captured in the Krishna estuary mangroves in January 1979 but is believed to have reached there from elsewhere (Bustard & Choudhury, *in press*)], virtually restricted to the 176 sq. km. Bhitar Kanika Sanctuary in Orissa, which was declared for the species under the Government of India Project and very rare in Sundarbans, (FAO 1974).

The Andaman and Nicobar Islands constituted a major shelter for this species until recently, and apparently, large populations existed there (Anon. 1931). However, the rate at which the main islands are being settled and forest lands encroached, combined with the high incidence of poaching, and large-scale egg robbing recorded in North Andaman in 1978 (Choudhury & Bustard 1980) indicates that these populations have an uncertain future.

Two pockets of the saltwater crocodile still occur, therefore, on mainland India (in Orissa and West Bengal) together with much reduced populations in the Andaman and Nicobar islands. The latter populations presumably have had some interchange with those in Burma, and in the case of the Nicobars, with Sumatra. Similarly, the coastal populations were more or less contiguous from Burma to Cochin. The present situation is that interchange between the Sunderbans and Bhitar Kanika populations is now unlikely and the Andaman-Nicobar populations are discrete from either.

REASONS FOR DECLINE

The likely extinction of the saltwater crocodile will be result of a number of factors some operating sequentially and some together.

1. *Commercial hide hunting.* Historically the reason for the massive depletion in numbers throughout its entire range was commercial demand for its hide. Reptile leathers have long been held in very high esteem. The most sought after of the reptilian leathers has always been that of crocodiles. The saltwater crocodile has an unsurpassed hide among the world's twenty-two species of crocodilians. This is because, this giant of crocodilians has greatly reduced armour, perhaps, as a result of its extremely aquatic nature. The hides of heavily armoured crocodiles are difficult (expensive) to process due to the heavy ossification of the scutes (known as "buttons" in the trade) with the result that, in all but small individuals, much of the total skin area is unusable. The saltwater crocodile hide is largely devoid of such problems.

Furthermore, as pointed out by Neill (1971) the large average size, as well as the reduced armour, assures the hide-hunter of a handsome profit. Neill stressed: "Man is the greatest enemy of the estuarine crocodile and the species is rapidly being exterminated."

The coastal mangrove-fringed tidal swamps and associated river systems favoured by this species, are in general inhospitable to man and in most parts of the world people formerly entered this ecosystem only to hunt the saltwater crocodile. It is important to realise that enormous sums of money were made by certain individuals. The senior author personally knows of one shooter who claimed to have shot over 40,000 crocodiles in North Queensland and in Papua New Guinea probably more than half belonging to this species.

Although the saltwater crocodile now enjoys legal protection in at least some parts of its range (e.g. India, Australia) prevention of poaching requires effective enforcement in the field and any sustained level of poaching could wipe out the small remnants of the former large populations which survive today. This threat is still very much alive.

Commercial hunting for the hide took place in India, as elsewhere, resulting in an equally massive depletion of the population.

2. *Loss of habitat*. The phase of massive depletion in crocodile populations is now past, but the threat to the species' future survival has intensified not decreased. This is because the very habitat of the species is now threatened by land reclamation/drainage of swamps and clearing of mangroves. Throughout most of its geographical distribution the species is closely tied to the mangrove ecosystem. With the threatened loss of this whole ecosystem the saltwater crocodile will have lost its habitat. The threat now is to the very vulnerable survivors—vulnerable because their numbers have shrunk so drastically as a result of the hunting phase, and with this their average size, threatened because the habitat is contracting rapidly—nowhere more so than in India.

Habitat destruction in India has been very much worse than the mean situation elsewhere in the geographic range. This, in part, reflects the massive depletion of India's forests in the last three decades, as a result of the ever increasing timber requirements for fuel and house construction of the rapidly expanding population. The mangroves have not been immune from this, and indeed, have proved most vulnerable. This is because:

a. mangrove forests are not considered to be valuable in economic timber terms in India, and, therefore, have a low protection and management priority with the State Forest Departments,

b. the alluvial soil built up by the mangrove ecosystem is extremely fertile, and when reclaimed high quality cultivation land is obtained, and

c. the ecological significance of the mangroves—as a barrier to cyclone damage, beach erosion and as a natural spawning/nursery ground for many species of marine fish, prawns and crabs has not been properly appreciated. So the loss of India's mangroves continues today.

3. *Animosity*. Crocodiles suffer from a low level of public esteem. The saltwater crocodile, because of its very large size, and its existence in a habitat which is itself frightening to man, is greatly feared. There have also been instances of attacks on humans, mostly by nest-guarding females (Bustard & Choudhury, *in press*). These, greatly exaggerated, have helped to turn the hand of man firmly against the species. There was no legislation to protect the species anywhere in its worldwide range until the massive depletion had already occurred.

4. *Use as food*. The saltwater crocodile is hunted as food in various parts of its range.

This subsistence hunting, when not associated with commercial hide-hunting, is not usually dangerous to the population and has existed as part of the species' ecology since time immemorial. The natural increase of the population is well able to cope up with such losses in the absence of commercial hide-hunting provided there is not an explosion in the population of the hunters.

There is little eating of cocodile meat in India, apart from some tribal groups, however, the eggs are widely eaten. These are a good source of nourishment, particularly valuable where hens' eggs are rare or expensive—as in the Andamans.

5. *Medicinal uses.* In India, there have been additional, subtle pressures on the species not found in many parts of its non-Indian range. These include medicinal demand for parts of the crocodile and/or its eggs. The liver, spleen and particularly the gall bladder and also the fat of the crocodile, are highly esteemed medicinally. The gall bladder is believed to cure eye diseases such as cataract, the liver and spleen bronchitis, and the fat to be remedial for rheumatism. In some areas the eggs are also believed to have medicinal value resulting in enhanced egg hunting (Choudhury & Bustard, *in press*).

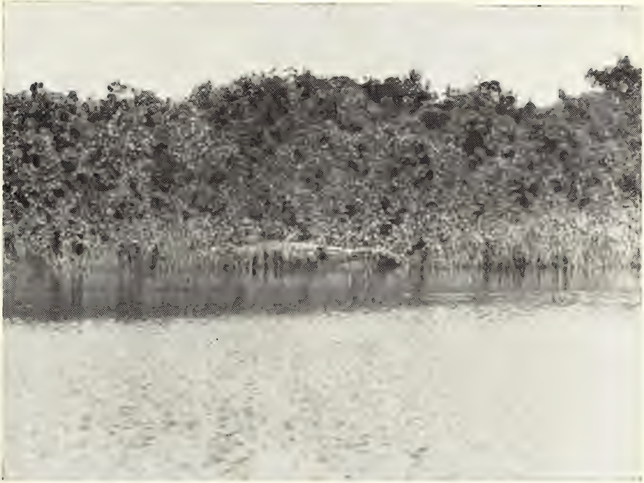
CONSERVATION PROGRAMMES

The first conservation programme for the saltwater crocodile started in Papua New Guinea following Bustard's Report to Government in 1967 (Bustard 1967, 1969). This has now grown into a large-scale project, tied in to the commercial economy of the swamplands. This Project, now receiving assistance from UNDP/FAO, will have major conservation impact if it succeeds in combining the conservation of saltwater crocodiles with successful village farming as proposed by Bustard.

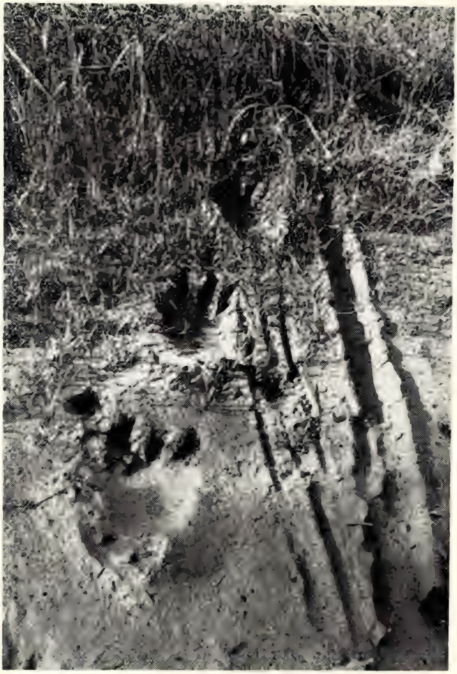
In Australia, the first legislation to protect the saltwater crocodile was gazetted by the Government of Western Australia in 1971 as a result of Bustard's (1970) report on the status of the species in the State. Western Australia also gazetted the first sanctuary anywhere in the world specifically for the saltwater crocodile in 1971. Meanwhile, conservation studies aimed at commercial production of skins, and a sound conservation programme by tribal aborigines were commenced by Bustard at Edward River, Cape York, North Queensland, Australia. This work continues on a small pilot research basis but has not reached the commercial phase of Papua New Guinea. Bustard's highlighting of the conservation status of the saltwater crocodile in Australia (see earlier references) has resulted in very extensive studies on the species by Messel's group (Messel *et al.* 1977, 1978), which are bound to have a useful impact on its conservation at least within Australia.

In India the Wildlife (Protection) Act, 1972, which listed the saltwater crocodile together with India's two other species of crocodilians in Schedule I (fully protected at all times) was a most significant step. This legally banned all crocodile hunting in India. Similarly, Export Instruction No. 46/73 forbade the export of crocodiles and gharial, their hides or products therefrom. This Government of India Act was taken up by all States in India. Enforcement of the Act became a problem and has been overcome with varying degrees of success. The initiation of even a small-scale project on the species has enormous conservation effect, since the presence of even a very few dedicated workers in India has been found to be an effective deterrent to poaching.

The present conservation status of the species is presented below on a State by State



Above: Large male Saltwater Crocodile (over 6.5 m) in one of the typical basking situations in the Bhitar Kanika Wild Life Sanctuary, Orissa. Such large individuals are extremely rare in most of the species' distributional range today.
Below: A typical 'blank' (Siddhu 1963) in the mangroves of Coringa Reserve Forest (now Coringa Wild Life Sanctuary), Godavari delta, Andhra Pradesh. These result from clear felling in the past and show little/no mangrove regeneration.



Above: Spoor marks of a large male Saltwater Crocodile (over 5 m) the hind foot impressions are seen on the left and on the right the massive rut left by the tail. The hind foot impressions, from which total length was established, measured 40-45 cm *Below*: Preferred basking area of a 3.5-4 m Saltwater Crocodile. The many foot imprints and the semi-circular slide mark should be noted. At high tide this individual will be basking in the grass like the male shown in Plate I.

basis.

1. Orissa. The entire remaining mangrove forests of the Brahmini-Baitarani delta, known as Bhitar Kanika, and comprising 176 sq. km, was declared a sanctuary in May 1975. In the same month, fishing was banned within the sanctuary. This latter action was essential as all poaching activity was carried out by people from inter-state visiting the area under the pretext of fishing. Furthermore, crocodiles readily become entangled in fishing nets and drown or are clubbed to death. Clear-felling had been practised on an extremely short rotation cycle and was threatening the very future of the mangrove forests. Subsequently (1976) the State Government of Orissa completely ceased mangrove felling operations in the entire sanctuary area.

The sanctuary area comprises part of the ex-zamindari lands of former Raja of Kanika. Rajasaheb Kanika has long been extremely interested in saltwater crocodiles and is very knowledgeable about them. Although he allowed hunting under licence, this was organised so that the species would be preserved. The massive depletion in numbers took place later in the 1950's and early sixties. At the end of 1976 the census carried out by Mr S. Kar, Research Scholar working on saltwater crocodile under the senior author through the State Forest Department Crocodile Project, gave a total of thirty-five adults and only six in the age classes about to recruit to the breeding population. It is interesting that following twenty months of conservation-research-management of the area there were 61 young crocodiles between 1-1.4 m—hatchlings of the 1974 season. (Kar and Bustard, *in press*). This contrasts markedly with the situation facing the young of the previous year (1973), which by late 1975, had "virtually all disappeared, presumbaly as a result of poaching activities prior to the declaration of the sanctuary" (FAO 1975). Clearly, the greatly enhanced survival observed at the end of 1976 is a result of the ban on fishing and the protection afforded to the sanctuary area.

The Orissa Project, following the "rear and release" technique described in FAO (1974), proposes to increase the breeding population to several 100 adult individuals and, thereafter, to manage the population at around this optimal level. This is being done by collecting all available natural nests as soon after egg laying as practical for safe hatching incubation and subsequent rearing of young to a release size of 1 metre. First releases back into the wild took place in 1977 (15 animals). And this, combined with the excellent survival of juveniles in the wild described above, boosted the potentially recruiting segment of the population over twelve times. This is an excellent illustration of the ease with which a population can begin to recover, if afforded stringent protection. The 1978 release (of 80 crocodiles) has boosted the recruiting segment over 25 times, since 1975.[4] The conservation programme will ensure that these released crocodiles have every opportunity to recruit to the breeding cohort of the population without the risk of being killed by poachers. The definitely recorded survival of the 1977 releases was 80 per cent after two full years had elapsed (it may, of course, have been even higher).

2. West Bengal. A project for the saltwater crocodile was taken up by the State Forest Department in Sunderbans in 1976. One nest was collected from the wild for captive incubation and rearing of young. Excellent survival was obtained and the immature crocodiles will be released during winter

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[4] A further thirty were released in January 1980.

1978/79.[5] Sunderbans is the largest mangrove area in the world. A large part of it is in Bangladesh but the Indian portion extends to 200,000 hectares (Blasco 1977). A portion of this is already included in the State Project Tiger Reserve, protection should be good and the potential for the saltwater crocodile excellent.

3. ANDHRA PRADESH. The major remaining mangrove area in the State, Coringa Reserve Forest, in the Godavari delta, was declared a sanctuary (Coringa Wild Life Sanctuary) in July 1978 with the aim of rehabilitating the saltwater crocodile, extinct in Andhra Pradesh. This is being done by egg collection in the Andaman Islands and captive rearing at Hyderabad in order to build a stock of the species. Three 1.2 m crocodiles hatched from eggs collected from the Andamans, were released into this area in March 1978. Further releases are planned.

4. TAMIL TADU. The sole remaining mangrove area is Pitchavaram in the Cauvery delta. This area has been suggested as a rehabilitation site for the saltwater crocodile in Tamil Nadu. However, the area is extensively fished and it may not be possible to reconcile the conflicting requirement of crocodile and fishermen.

5. ANDAMAN AND NICOBAR ISLANDS. Virtually nothing is known about the quantitative status of the saltwater crocodile in this Union Territory. Chaterjee (1977) noted that the saltwater crocodile; "is widely distributed and is found in almost all the islands of the Andaman and Nicobar groups. Unrestricted persecution of these animals by local people in the past has greatly reduced their numbers. Much destruction is also caused by collecting their eggs whereby the entire brood is wiped out. The slaughter of these animals has been greatly reduced since the implementation of the Wildlife (Protection) Act."

Whitaker and Whitaker (1978) highlighted the need to carry out detailed surveys to determine the crocodile population and currently available habitat, a conclusion with which we concur. They also advocated better enforcement of protection by posting adequate field staff.

The Government of India Crocodile Project has been interested to extend conservation work to the Andamans and to have the Andaman Forest Department as a full member of the Project by initiating a Government of India-assisted Crocodile Project in the Territory.

The Andaman Forest Department has allowed the Project to collect eggs since 1976. However, due to logistic difficulties, it was not possible to undertake a full egg collection until 1978 when this was carried out by the Andhra Pradesh State Project by one of us (Bustard & Choudhury *in press*). In 1979, the Andamans Forest Department started their own project with the construction of a holding capacity and the collection of eggs.

IMMEDIATE PROBLEMS FACING THE SPECIES IN INDIA

1. *Habitat loss.* Doubts about the continued survival of the mangrove habitat, both on the mainland and in the Andamans, gives rise to serious concern for even the medium-term future of the saltwater crocodile. The model rehabilitation programme being operated by the Orissa Forest Department at the Saltwater Crocodile Research and Conservation Centre at Dangmal, within the Bhitar Kanika Wildlife Sanctuary declared for the

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[5] Forty 1976 hatchlings were released in May, 1979.

species under the Project, will be of no avail unless the habitat can be effectively protected against encroachment. This problem is political and applies equally to other projects under initiation or planned.

2. *Large-scale egg robbing in Andamans.* Choudhury & Bustard (1980) have indicated the very high level of nest predation by settlers (84%) on North Andaman. They also noted five instances of nest-guarding females being killed at the nest during the 1978 nesting season. This represents a loss of 17% of the nesting females in a single season. Clearly under such a regime, in a species which does not commence breeding until it is at least 10 years old, the population will soon become extinct. This could be effectively stopped by extending the Government of India Crocodile Project to the Territory.

NEED FOR NEW INCENTIVES IF THE SPECIES IS TO SURVIVE

Now that India has adopted suitable legislation—the Wild Life (Protection) Act, 1972—it is necessary as a second step to see that it is fully implemented. Bustard (1969 c), in a world-wide review on problems of crocodile conservation, wrote; "Few Governments have suitable *conservation legislation* for crocodiles. Where legislation does exist no attempt is being made to enforce it." This legislation should be complemented by the creation of good National Parks or Sanctuaries for crocodiles. It should be noted that, as pointed out by Bustard (1971), National Parks and other categories of refuges are not, and can never be, any more than tools in crocodile conservation. Bustard (1971) concluded that the creation of National Parks as an act in isolation would be of little help to crocodile conservation.

The third step in India is to ensure that the National Park and sanctuary areas are inviolate—both against legal and illegal encroachment and all kinds of poaching activity. This requires active co-ordination at the Central level and staffing by a cadre of motivated and specially trained protection staff.

The various saltwater crocodile habitats in India are discussed below in the light of the requirements set out above.

ORISSA

1. Ten per cent of the sanctuary area was reportedly encroached during the year 1977/78 (de Waard 1978). The ex-zamindari forests which comprise the sanctuary have to be clearly demarcated to prevent encroachment.
2. The many villages within the sanctuary have to be carefully demarcated to prevent encroachment, which will otherwise obviously take place increasingly with population growth.
3. Adequate supplies of timber for fuel purposes will have to be maintained at a number of conveniently located timber depots within and around the sanctuary (Kanungo 1976).
4. Protective staff will, of course, have to be maintained as an effective deterrent to poaching activities.
5. The research husbandry unit will have to provide continuously updated figures on the status and break-up of the crocodile population within the sanctuary, so that proper assessment of the performance can be made and future requirements planned on a sound scientific management basis.
6. In order to retain the co-operation of the local people, so essential for a project of this kind, the crocodile management programme should result in real material

benefit to the people. This would be possible by tying conservation in the sanctuary to commercial crocodile farming at the village level.

7. Putting such an economic price tag on the sanctuary may be the most effective method for ensuring its future integrity.

West Bengal

There is need for the crocodile project in West Bengal to gather momentum. Otherwise there are at present no measures specific to this area which require implementation. It will, of course, be essential to completely ban fishing in the crocodile rehabilitation sanctuary areas.

Andhra Pradesh

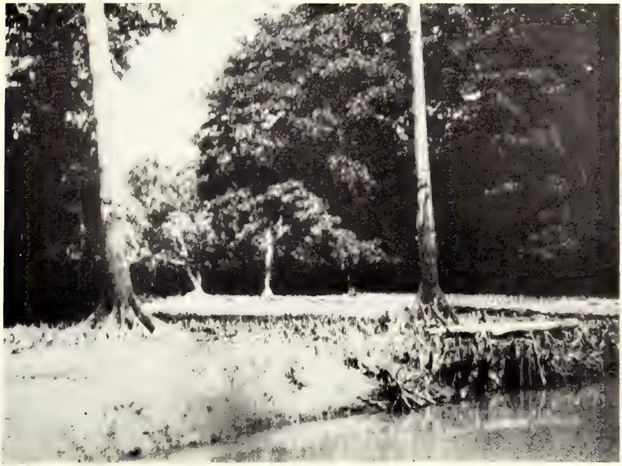
1. The recently declared sanctuary will have to be staffed and become operational.
2. If the sanctuary is to be of any use, fishing will have to be banned throughout the entire sanctuary as was done in the Bhitar Kanika Saltwater Crocodile Sanctuary, Orissa, immediately following declaration.
3. Felling of mangroves has ceased in the sanctuary. This action must be maintained for the following reasons:
   - *a.* the mangroves are not regenerating well following clear-felling on a twenty year rotation cycle. Even cursory examination shows that in many areas there will not be a further crop after twenty years.
   - *b.* furthermore, the clear-felling practice used in mangrove areas encourages encroachments—there is a strong tendency for people to move into the felled areas and take up cultivation.
   - *c.* finally, the amount of disturbance caused by clear-felling is quite inconsistent with a small sanctuary like this.
4. Proper protection should be given to the total land area of the sanctuary so that the mammal fauna—especially the ungulates—can recover. These form an important part of the diet of adult saltwater crocodiles, and as in the case of tiger, healthy populations of deer and wild pigs are the best guarantee against predation on domestic stock. In the Bhitar Kanika Wildlife Sanctuary the chital herds have responded excellently to the protection and wild pigs have increased to such an extent as to become a nuisance on adjacent agricultural lands.

Tamil Nadu

Before a rehabilitation programme could be taken up in the Cauvery delta mangrove, it would be essential to ascertain that it would be possible to completely prohibit fishing throughout the proposed sanctuary area. This matter is under investigation.

The Andaman and Nicobar islands

1. A crocodile project should be taken up in this Union Territory under the Government of India Project, Crocodile Breeding and Management, receiving technical assistance from FAO/UNDP.
2. In order to implement such a project it will be essential to strengthen the Wildlife Wing of the Andamans Forest Department. The sequential tasks of the Project would be:
   - *a.* to carry out surveys of the Andaman-Nicobar Group in order to establish the location of the best remaining saltwater crocodile populations and relate these to areas where the creation of sanctuaries will be feasible.
   - *b.* to take up conservation/husbandry



Above: Felling of mangroves for fuel-wood and house construction.
Below: Clearing for cultivation along the sweet-water creeks used for nesting by the Saltwater Crocodile. Note the bamboo fencing erected to keep out ungulates.

Above: Eighteen month old juvenile Saltwater Crocodiles (mean 1.1 m in total length) in the Bhitar Kanika Research and Conservation Centre, Dangmal, Orissa.
Below: A general view of one part of the above hatchling pool complex.

work *within* the sanctuaries as they are gazetted.

c. to assist the Wildlife Wing of the Andamans Forest Department in reducing nest-robbing and other poaching activities.

3. It is *urgent* to locate and gazette suitable sanctuary areas prior to increased settlement.

MASTER PLAN FOR THE FUTURE

The master plan for the future combines the creation, management, and operation of a net-work of specially gazetted sanctuaries/ National Parks with the creation of a cadre of highly trained and motivated wildlife staff. Commercial utilisation is seen as an important tool in the crocodiles' conservation.

A. SANCTUARIES

MAINLAND

1. The future integrity of the Bhitar Kanika Sanctuary must be guaranteed.

The Bhitar Kanika population of saltwater crocodile is remarkable in still having quite a number of very large individuals in the population. In most of the species range these large individuals were wiped out many decades ago. Ninty-three per cent of the adults in this sanctuary measure more than 3.5 m and ten per cent exceed 6 m (Kar & Bustard, *in press*). The sanctuary also has the distinction of being the habitat of the largest crocodile of any species in the world known to scient (Daniel and Hussain 1974, Bustard *in press*, c). Bustard, on the basis of measurement of the intact skull, estimated this crocodile to be 7.35 m.

In view of this, and the excellent conservation management programme being operated by the Wildlife Wing of the Orissa Forest Department it is essential that this population be preserved for posterity. The threat to the population arises from the threat to the sanctuary itself. To ensure the survival of this unique population of a critically endangered species, Government of India should assume responsibility for the territorial integrity of the sanctuary. This might best be achieved by making the sanctuary a National sanctuary as has been done in case of the gharial (*Gavialis gangeticus*) in a tri-state sanctuary (U.P., M.P. and Rajasthan) on Chambal river.

The size of adults of the Bhitar Kanika population is very much larger than the population studied on North Andaman (Choudhury & Bustard 1980). Discussion with a number of crocodile hunters, on the basis of large samples killed a decade or more ago, confirms that the Bhitar Kanika population even then consisted of very much larger crocodiles than those of North and Middle Andamans.

In any conservation programme for the saltwater crocodile in India the Bhitar Kanika sanctuary will be a lynch-pin. This is because this is the only scheme for the saltwater crocodile in India which has been fully implemented. It will still be essential to ensure the territoial integrity of this area even if the embryonic scheme in Sunderbans becomes a success. This is in part because it is most unwise to place total reliance for a species survival on the animals within one single sanctuary.

2. A viable population of saltwater crocodiles, should be built up in Sunderbans within the Project tiger reserve where they can be assured of good protection.

ANDAMAN AND NICOBAR ISLANDS

The importance of the Andamans for the saltwater crocodile lies in the following considerations:

- *a.* there may still be good populations in less accessible areas of the Group
- *b.* if these areas are located quickly it should be possible to gazette sanctuaries in virgin mangrove forests, prior to encroachment. Clearly, it is much easier to manage a sanctuary without human settlement within it
- *c.* the Andamans is the home of the most isolated population of saltwater crocodiles in the Indian region. North Andaman lies at a distance of 896 km southeast of the mouth of the Hoogly and 1300 km East of the nearest area of the mainland. In the case of the Andamans, urgent action is essential because of rapid rate of settlement and consequent encroachment. It is important to gazette at least one large sanctuary and preferably two, for the species in this Union Territory.

B. COMMERCIAL UTILISATION

The saltwater crocodile is an ideal species for economic management. Exploitation, provided it is on sustained yield basis or from farms in which all products are produced from eggs laid in the farm, in no way conflicts with conservation. On the contrary this can provide an important tool for the conservation of the species resulting in a good level of management in the sanctuaries. If the sanctuaries and associate rearing farms can give good revenue to government then the integrity of the sanctuary areas is assured and with that the saltwater crocodile.

C. STAFF TRAINING

The Government of India Project, Crocodile Breeding and Managment, under technical assistance from FAO/UNDP, has established a Central Institute—the Crocodile Breeding and Management Training Institute—charged with the training of Forest Department personnel. The training programme covers not only all aspects of crocodile husbandry and management but also sanctuary and wildlife management. This Institute was created because of the obvious need for a cadre of well-trained management personnel without which even the best planned sanctuary programme of government could not hope to succeed.

The senior author has also been providing highly technical training of seven Ph.D Research Scholars recruited at post-M.Sc. level. Their contribution to the Project has been substantial and the junior author of this paper is one of them.

SPECIES WORLD-WIDE SURVIVAL PROSPECTS

Neill (1971) concluded his account on this species with these words: "In the 1950's and 1960's with the price of crocodilian leather skyrocketing, hundreds of thousands of estuarine crocodiles, were killed annually and its disappearance from all parts of its ranges is to be expected within a very few years."

It is our task to ensure that this gloomy prognosis does not prove accurate—at least for India. Neill considers that probably all the living crocodilians are doomed to extinction. The Crocodile Breeding and Management Project of the Government of India has shown that this need not be the case. The gharial is well on the way to being saved and if proper decisions are taken now the saltwater crocodile can look forward to a secure future within India, even if it is doomed to extinction throughout most of its range.

MAJOR RECOMMENDATIONS

The following recommendations are suggested in order to implement the proposed Master Plan:

1. Bhitar Kanika Sanctuary, Orissa should become a National sanctuary (100 per cent Central funding for both capital and recurrent costs).
2. The Government of India, FAO/UNDP assisted Project, Crocodile Breeding and Management should be extended to the Union Territory of the Andaman and Nicobar Islands with immediate effect. Once again this will have to be on the basis of 100 per cent Central financing. The reason a scheme has not been initiated already is lack of staff in the Wildlife Wing of the Andamans Forest Department. This Department faces special difficulties not being a service department.
3. Every effort should be made by the Government of India Project to encourage State schemes (under the Central assistance programmes to National Parks and Sanctuaries) in order to rehabilitate the saltwater crocodile elsewhere. It may not now be possible to do anything in Kerala, but Andhra Pradesh should be encouraged and possibilities in Tamil Nadu should be investigated.

ACKNOWLEDGEMENTS

Both of us acknowledge the co-operation of our respective organisations—The Food and Agriculture Organisation of the United Nations and the Andhra Pradesh State Forest Department—and assistance from the Orissa Forest Department, especially, Mr. Sudhakar Kar, and the Andamans Forest Department.

REFERENCES

ANNON. (1931): Census report for Andaman & Nicobar Islands, Govt. of India. New Delhi.

BIDDULPH, C. H. (1936): A Mugger (*Crocodylus porosus*) with a broken jaw. *J. Bombay nat. Hist. Soc. 29* (2): 421.

BLASCO, F. (1977): Outlines of Ecology, Botany and Forestry of the Mangals of the Indian Subcontinent. *In* Ecosystems of the World. *1.* Wet Coastal Ecosystems. V. J. Chapman (Ed.) Elsevier Scientific Publishing Company, Amsterdam.

BUSTARD, H. R. (1967): Report on the Crocodile Skin Trade in the Territory of Papua and New Guinea with Recommendations for the Future Development of the Industry. Unpublished confidential report to Minister.

———— (1969a): The Future of Australian Crocodiles. *Wildlife of Australia. 6* (2): 40-43.

———— (1969b): A Future for Crocodiles. *Oryx 10* (4): 249-255.

———— (1969c): Crocodilians of the World—Summary of the present position. *W.W.F. Yearbook.* Morges. Switzerland.

———— (1970): Report on the current status of crocodiles in Western Australia. *Dept. Fish Fauna. West. Aust. Rept.* No. 6.

———— (1971): National Parks, Refuges, etc. as tools in Crocodile Conservation. *In Crocodiles. I.U.C.N. Publ. N. S. Suppl. Pap.* No. *32*: 145-8.

———— (1978): Crocodile Population Ecology and Management. *Zool. Surv. Ind. Symp. Anim. Ecol.*

———— (*in press,* a): General Status of Crocodilians in India. *In* Indian Crocodiles—Conservation & Research. Occ. Publ. *1*: *Cent. Croc. Br. Mgt. Trg. Inst.* Hyderabad, India.

———— (*in press,* b): The Saltwater Crocodile Conservation Programme in India. *In* Indian Crocodiles—Conservation & Research. Occ. Publ. *1. Cent. Croc. Br. Mgt. Trg. Inst.* Hyderabad. India.

———— (*in press,* c): Record size saltwater crocodile (*Crocodylus porosus,* Schneider). Orissa. India. *Br. J. Herpet.*

———— & Choudhury, B. C. (*in press*): Parental care in the Saltwater Crocodile (*Crocodylus porosus*, Schneider). *In* Indian Crocodiles—Conservation & Research. *Occ. Publ. 1. Cent. Croc. Br. Mgt. Trg. Inst.* Hyderabad. India.

Chaterjee, S. K. (1977): Wildlife in the Andaman and Nicobar Islands. *Tigerpaper. 4* (1): 2-5. FAO, Bangkok.

Choudhury, B. C. (*in press*): Status, Conservation and Future of Saltwater Crocodile in North Andaman Island. *In* Indian Crocodiles—Conservation & Research. Occ. Publ. *1. Cent. Croc. Br. Mgt. Trg. Inst.* Hyderabad. India.

———— & Bustard, H. R. (1980): Predation on natural nests of the Saltwater Crocodile (*Crocodylus porosus*, Schneider) on North Andaman Island with notes on the crocodile populations. *J. Bombay nat. Hist. Soc. 76*(2): 311-323.

Daniel, J. C. & Hussain, S. A. (1974): The record (?) Saltwater Crocodile (*Crocodylus porosus* Schneider). *J. Bombay nat. Hist. Soc. 71* (2): 309-12.

Deraniyagala, P. E. P. (1939): The Tetrapod Reptiles of Ceylon. *1.* Testudinates and crocodilians. Colombo Museum. Ceylon.

FAO (1974): India. A preliminary Survey of the Prospects of Crocodile Farming (based on the work of H. R. Bustard) FAO. Rome (FO:IND/71/033) Oct. 1974.

———— (1975): India. Gharial and Crocodile Conservation Management in Orissa (based on the work of H. R. Bustard) FAO. Rome (FO: IND/71/033) Dec. 1975.

Gunther, A. C. L. G. (1864): The Reptiles of British India. Roy. Soc. London.

Honeggar, R. E. (1975) (Ed.): Red Data Book *3.* Amphibia and Reptilia. IUCN Morges. Switzerland.

Kanungo, B. C. (1976): An Integrated Scheme for Conservation of Crocodiles in Orissa with Management Plan for Satkosia Gorge and Bhitar Kanika Sanctuaries. Forest Dept. Cuttack. Orissa. India.

Kar, S. & Bustard H. R. (*in press*): The Saltwater Crocodile (*Crocodylus porosus*, Schneider) Population of Bhitar Kanika Sanctuary. Orissa. India. *In* Indian Crocodiles—Conservation & Research. Occ. Publ. *1. Cent. Croc. Br. Mgt. Trg. Inst.* Hyderabad. India.

Messel, H., Burbidge, A. A., Wells, A. G. & Green, W. J. (1977): The status of the Saltwater Crocodile in some River Systems of the North-West Kimberly, Western Australia. Rept. No. 24. *Dept. of Fish. & Wildlife. West. Australia.*

————, Wells, A. G. & Green, W. J. (1978): Status of *Crocodylus porosus* in tidal River Systems of Northern Australia. Fourth Working Meeting. *IUCN Crocodile Specialist Group.* Madras. India.

Neill, W. T. (1971): The Last of Ruling Reptiles. Columbia Univ. Press. New York.

Waard, J. M. de (1975): India. Economic Potential of Gharial and Saltwater Crocodile Schemes in Orissa with Notes on the Sea Turtle Industry. FAO. Rome (FO:IND/71/033).

Whitaker, R. & Whitaker, Z. (1978): A preliminary Survey of the Saltwater Crocodile (*Crocodylus porosus*) in the Andaman Islands. *J. Bombay. nat. Hist. Soc. 75* (1): 43-49.

FRESHWATER SNAILS OF GWALIOR (M.P.)[1]

H. C. GOEL[2] AND C. P. SRIVASTAVA[3]

(*With nine text-figures & a map*)

INTRODUCTION

With few exceptions molluscs serve as the only or as one of the intermediate hosts of digenetic trematodes and thereby acquire a significant importance from the point of view of public and veterinary health. While working on the secondary host of schistosomiasis it was deemed necessary to study the freshwater snail fauna of Gwalior city and its neighbourhood.

Few references are available on the occurrence of freshwater snails of various places in India [Annandale *et al.* 1921 (a); Annandale & Srinivas Rao 1925; Tonapi & Mulherkar 1963; Annandale *et al.* 1921 (b)] but no record is available about the commonly occurring snails of Gwalior. The present paper is a brief account of various aquatic snails together with their habitat and a list of trematode larvae parasitising these snails in India (Table 1).

MATERIALS AND METHODS

The specimens were collected regularly once a fortnight from different aquatic habitats with the help of various snail collecting devices such as long handled kitchen sieve, Dipnet, Drag Scoop etc, (Anon. 1965) from various places in and around Gwalior city as shown in the Map. The specimens were brought to the laboratory and kept under observation to find out the release of trematode larvae so as to confirm them as positive vectors.

The snails were then preserved in seventy per cent alcohol and were identified in consultation with Zoological Survey of India, Calcutta. The collections were made at different sites uniformly in terms of man-hours. This gave a fairly good idea about the relative occurrence of various snails species.

Measurements of the specimens have been taken as per standard expressions (Ward & Whipple 1918, Barth 1958).

All measurements given here (Table 2) represent the commonly available size of the adult members of the species. The place of occurrence of different snail species has been expressed by number in Table 2 and has been correspondingly shown on the map

Family: VIVIPARIDAE

Vivipara bengalensis f. **typica** (Lamarck)

There are 5½ to 6½ rather inflated whorls with well marked suture. Shell ovate, sharply acuminate with a mouth angularly pointed above and rounded below. Umbilicus narrowly perforate. Outer lip almost semi-circular joining columellar margin by thin glassy deposit. Shell sculpture of fine longitudinal ridges forming fine irregular ribs or varias on the body whorl.

Colour olive green with alternating and

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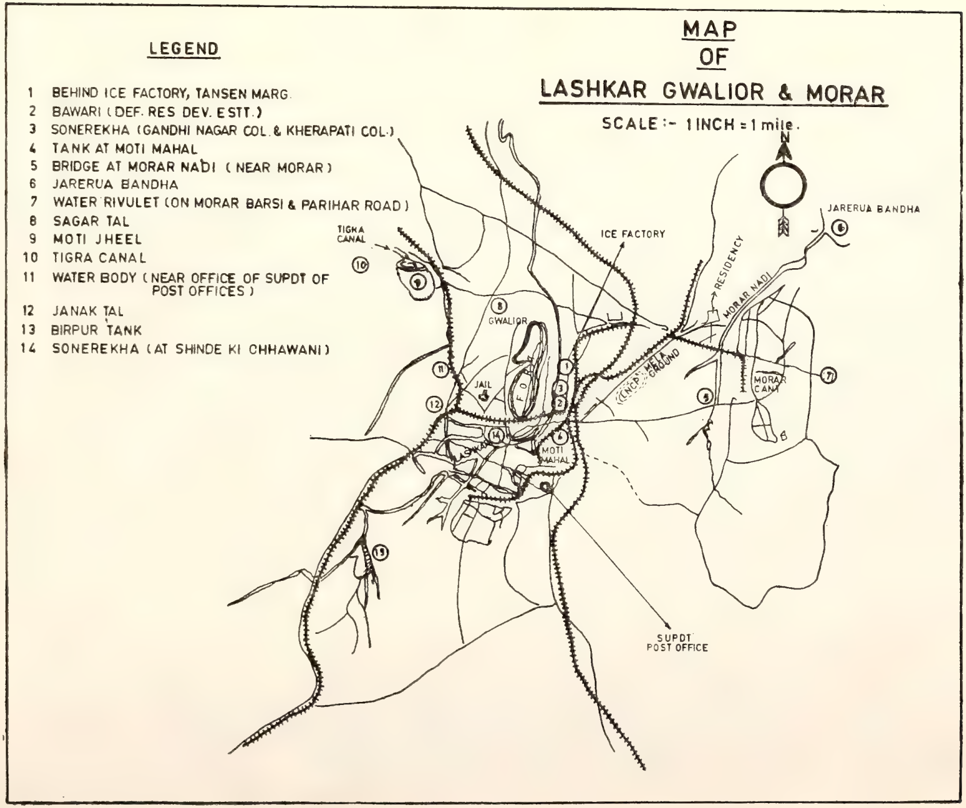
[1] Accepted August 1978.

[2] Institute of Nuclear Medicine & Allied Sciences, Probyn Road, Delhi-110 007.

[3] Defence Research & Development Establishment, Gwalior-2.


MAP
OF
LASHKAR GWALIOR & MORAR
SCALE :- 1 INCH = 1 mile.
N
LEGEND
1 BEHIND ICE FACTORY, TANSEN MARG.
2 BAWARI (DEF. RES DEV. ESTT.)
3 SONEREKHA (GANDHI NAGAR COL. & KHERAPATI COL.)
4 TANK AT MOTI MAHAL
5 BRIDGE AT MORAR NADI (NEAR MORAR)
6 JARERUA BANDHA
7 WATER RIVULET (ON MORAR BARSI & PARIHAR ROAD)
8 SAGAR TAL
9 MOTI JHEEL
10 TIGRA CANAL
11 WATER BODY (NEAR OFFICE OF SUPDT OF POST OFFICES)
12 JANAK TAL
13 BIRPUR TANK
14 SONEREKHA (AT SHINDE KI CHHAWANI)
TIGRA CANAL
ICE FACTORY
JARERUA BANDHA
RESIDENCY
MORAR NADI
GWALIOR
MELA GROUND
(NCP)
JAIL
F O
MORAR CANT
B
MOTI MAHAL
LASHKAR
SUPDT POST OFFICE
1
2
3
4
5
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11
12
13
14

TABLE 1

SNAIL HOSTS AND THEIR TREMATODE PARASITES

Snail	*Parasite*
1. *Indoplanorbis exustus*	i) *Schistosoma indicum* ii) *S. nasale* iii) *Cerecaria anuri* n. sp. iv) *C. sppericauda* n. sp. v) *C. Kotal* n. sp. vi) *C. rajai* n. sp. vii) *Furcocercous cercariae* viii) *Clinostome Group* (Cercaria develops into the radiae which infest the liver of snail).
2. *Vivipara bengalensis*	i) The cercaria resembles to *Azygia tereticola, A. sehago* and *A. acuminata* ii) *C. shikarii* n. sp.
3. *Lymnaea luteola*	i) *Schistosoma incognitum* ii) *Schistosoma nasale* iii) *Echinostome cercaria & its meta cercaria* iv) *Cercaria quadradena* v) *Orientolulherzia dattae* vi) *Cercariae leotai* n. sp., *C. rajai* n. sp., *C. mathurenensis* n. sp.
4. *Lymnaea acuminata*	i) *Schistosoma nasale* ii) *Fasciola gigantica*

Note:— The information is compiled from the following publications:—

1. Emile A. Malek & Thomas C. Cheng, 1974, Medical & Economic Malacology. Academic Press, New York & London pp. 398
2. Zoological Abstracts Helminthology Vol—II Pt—II
   Section: prepared under the auspices of the Madhya Pradesh Zoological Society, Bhopal. (1973).

TABLE 2

OCCURRENCE AND DIMENSION OF VARIOUS SPECIES OF SNAILS AVAILABLE AT GWALIOR

SNAIL SPECIES	OCCURRENCE (Refer Map)	No. examined	DIMENSION (mm)								
			LENGTH			WIDTH			OPERCULUM		
			Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
Indoplanorbis exustus (Deshayes)	6, 11	5	10	13.0	11.0	8.0	10.0	8.5	5	6.0	4.5
Lymnaea (*Pseudosuccinea*) *luteola* f. *impura* Troschel	1, 3, 5, 6, 9, 10, 13	5	14	18.0	16.0	7.0	8.5	8.0	8.0	5.0	6.0
Lymnaea (*Pseudosuccinea*) *acuminata* f. *rufescens* (Gray)	3, 4, 6, 9, 10, 11, 13	5	19	21	20	7	10	9.0	13	15	13.5
Vivipara bengalensis f. *typica* (Lamarck)	2, 4, 5, 6, 7, 8, 11, 12, 13, 14	5	24	32	28	16	20	17.5	11	15	13.0
Vivipara dissimilis (Müller)	6	1	—	—	21	—	—	15.0	—	—	—
Melanoides tuberculata (Müller)	3, 5, 6, 12	5	17	24	20	6	8	7.0	5	6	5.5
Melanoides (*Plotia*) *scabra* (Müller)	3, 5, 6. 7, 8	5	13	22	17	6	10	7.5	5	8	6.5
Gyraulus convexiusculus (Hutton)	6, 7, 8. 10, 14	5	4.5	6.5	5	2.5	4.5	3.0	1.5	3	2.0
Digoniostoma ceramepoma (Benson)	5	2	5.0	7.5	6	3.5	5.5	4.0	2.5	3.5	3.0

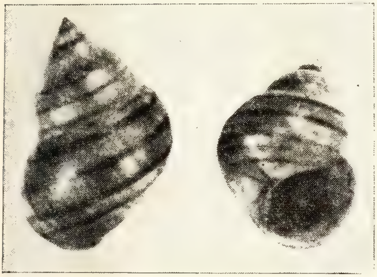

Fig. 1. *Vivipara bengalensis* f. *typica* (Lamarck) × 2

narrow dark brown spiral bands. *V. bengalensis* is abundant in the fresh water canals or ponds etc. throughout Gwalior. Snails remain attached to stones etc. on the banks of canal or ponds.

Vivipara dissimiles (Muller)

This species closely resembles *V. bengalensis* but the shell is broader and the body whorl marked with prominent spiral ridge that subsequently makes the aperture more rhomboidal than *V. bengalensis*. Sculpture consists of close-set, delicate, spiral striae, and oblique transpiral growth striae, which are prominent and well marked in the peripheral region of the body whorl. Umbilicus narrower than in *Vivipara bengalensis*. Shell dirty olive green in colour, the interior being dull bluish white tint.

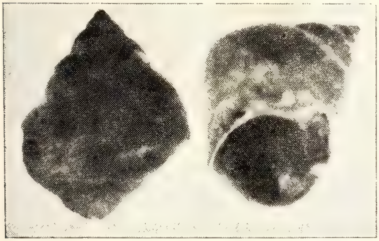

Fig. 2. *Vivipara dissimilis* (Muller) × 3

Family AMNICOLIDAE

Digoniostoma ceramepoma (Benson)

The species is rare in Gwalior and only two specimens could be collected during the Survey work from water logged area near Morar Dam. It closely resembles young forms of *Vivipara* sp. but is comparatively very small in size.

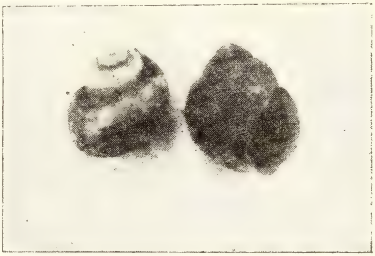

Fig. 3. *Digoniostoma cerамepoma* (Benson) × 4.

There are about 5 rapidly increasing inflated whorls with well marked suture and varix. Shell oblong, ovate, and obsoletely sculptured, with week growth lines. Umbilicus narrow and deep. Shell cinereous, shading to yellowish white. Aperture ovate, and a little oblique. Operculum, shelly, slightly concave, having about seven convolutions.

Family MELANIIDAE

Melanoides (Melanoides) tuberculatus (Muller)

Shell elongated with acuminate apex, whorls increase gradually from the apex to the mouth, and are moderately convex. Aperture oval, but narrowed above, and broad below. Mouth small, considerably less than one third the total length of the shell. Sculpture of transpiral, tuberculated, ridges with raised spiral striae. Body whorl normally devoid of transverse tuberculated ridges. Colour of the shell dark brown with distinct longitudinal wavy reddish marking. Interior of the shell is glossy with external marks faintly visible.

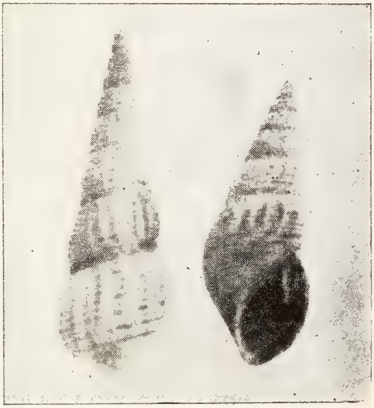

Fig. 4. *Melanoides tuberculata* (Muller) × 3.5.

It is found in slow flowing or stagnant water. Specimens are found attached to some substratum.

Melanoides (Plotia) scabra (Muller)

Shell markedly thick with acutely conical shape. Whorls have well developed angular shoulders provided with spinous projections. Aperture small, oval sinuous above and rounded below. Colour variable between pale brown to sandy brown with fine reddish transpiral wavy elegant marks.

It is found in abundance in slow flowing water to stagnant water usually attached to some substratum or lying free at the bottom.

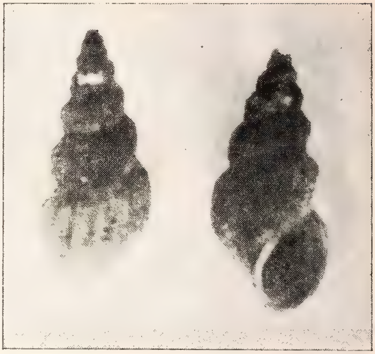

Fig. 5. *Melanoides* (*Plotia*) *Scabra* (Muller) × 3

Family LYMNAEIDAE

Lymnaea (Pseudosuccinea) acuminata f. **rufescens** (Gray)

The length of the suture at the base of the spire is not appreciable or is hardly longer

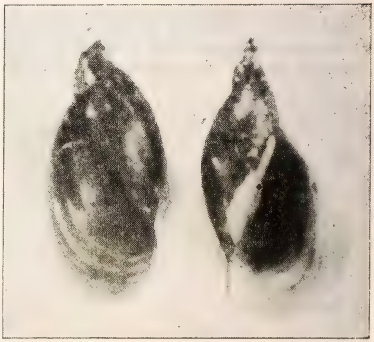

Fig. 6. *Lymnaea* (*Pseudosuccinea*) *acuminata* f. *rufescens* (Gray) × 2.5.

than the height of the spire. Anterior margins of the mouth of shell broadly rounded, or subtruncate. Outer lip of the shell dilated.

Shell ovately oblong, smooth, thin, and semitransluscent. Body whorl shortly angular above and inflated below the middle.

Apex pointed, spire short, narrow; aperture wide and columellar lip, twisted. Fine, close-set, transpiral striations exist on the surface of the shell. Colour of shell variable with a yellowish brown tinge. The body whorl is clearly demonstrated from the spire with an abruptly narrowed base.

The species is frequently available in clear water as well as in turbid, muddy water as compared to *L. luteola.*

Lymnaea (Pseudosuccinea) luteola f. **impura** Troschel

Spire as a rule about 1/3 as high as the shell and consists of 4 to 5 gradually increasing transverse whorls which are never appreciably convex. Suture always more or less transverse. Length of suture never less than the height of the spire. Mouth of shell ovate, evenly rounded anteriorly gradually narrowing towards its posterior extremity. The outer lip is never so extended or so convex in outline as that of *Lymnaea acuminata.* The columellar gallery is thin and broad; opaque white in colour. Shell smooth, glossy, with a pale yellow horny tinge. Shell sculpture consists of close-set fine transpiral striations.

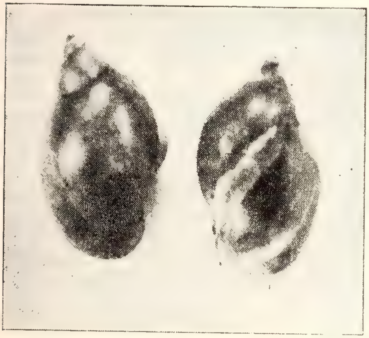

Fig. 7. *Lymnaea (Pseudosuccinea) luteola* f. *impura* Troschel × 3.

The snail commonly inhabits clean clear water as compared to *L. acuminata.*

Family: PLANORBIDAE

Gyraulus convexiusculus (Hutton)

Shell dextral having four to five whorls with deep sutures, very much depressed with the sunken spire giving the appearance of a flattened disc. Aperture oblique and lunately oval; outer margin smooth and much elevated, umbilicus wide. Surface smooth and pale horny in colour, bearing close-set oblique transpiral striae.

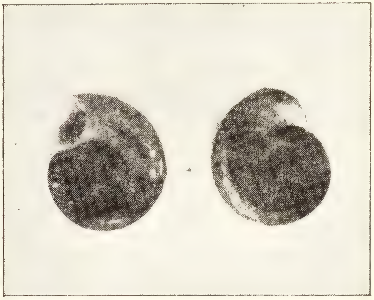

Fig. 8. *Gyraulus convexiusculus* (Hutton) × 5

G. convexiusculus inhabits clean fresh water of stagnant or slow running nature and even muddy polluted water.

Indoplanorbis exustus (Deshayes)

Shell discoidal, suture deeply impressed but the whorls are convex. Aperture ear shaped, when the shell is held with mouth on left. Shell sinistral; foot feebly sharp, relatively broad and short broadly rounded in front and pointed behind. Shell moderately thick, transpirally and finely striated throughout the body. Body-whorl has more distinct ridges and umbilicus is wide. Colour varies from locality to locality and varies from dull grey brown to reddish brown.

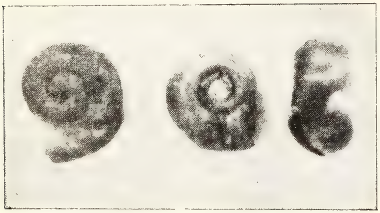

Fig. 9. *Indoplanorbis exustus* (Deshayes) × 3.

This snail is available in slow running water or small water bodies commonly available in the fields or on sides or road during rainy season. Remains attached to submerged stones or other objects.

ACKNOWLEDGEMENTS

We wish to express our sincere thanks to Shri S. L. Perti, Assistant Director, Vector Control Division, Defence Research & Development Establishment, Gwalior, for his encouragement and guidance and to Dr. S. C. Goel, Reader, Dept. of Zoology, University of Pune, Pune, for his help in preparing the manuscript. Thanks are also due to Director, DRDE, Gwalior for interest and to Dr. N. V. Subba Rao of Zoological Survey of India, Calcutta for identifying the snail species.

REFERENCES

ANONYMOUS (1965): Snail control in the prevention of Bilharziasis, *WHO, Geneva*, pp. 255.

ANNANDALE, N., SEWELL & SEYMOUR, R. B. (1921a): The Banded Pond Snail of India. (*Vivipara bengalensis*). *Records of Indian Museum 22*: 217-278.

ANNANDALE, N., PRASAD, B. & AMIN-UDDIN (1921b): The aquatic and amphibious Mollusca, Manipur. *Records of Indian Museum, 22*: 530.

ANNANDALE, N. (1922): Material for a generic revision of the freshwater Gastropod. Molluscs of the Indian Empire No. 5, Indian *Planorbidae*. *Records of Indian Museum 24*: 357-363.

ANNANDALE, N. & RAO, S. (1925): Material for a revision of the recent Indian *Limnaeidae* (*Mollusca, Pulmonata*). *Records of the Indian Museum, 27*: 137-190.

MANDAHL BARTH, G. (1958): Intermediate hosts of Schistosoma (African *Biomphalaria* and *Bulinus*). *WHO Monograph series No. 37 WHO Geneva*, pp. 132.

TONAPI, G. T. & MULHERKAR, L. (1963): On the freshwater Molluscs of Poona. *J. Bombay nat. Hist. Soc., 60* (1): 104-120.

WARD, H. B. & WHIPPLE, G. C. (1918): Freshwater Biology, Edited by Edmondson W. T. John. *Wiley and Sons Inc.*, USA., pp. 248.

A CONTRIBUTION OF THE VEGETATION OF CHAIBASA (SOUTH), SINGHBHUM DIST. (SOUTH BIHAR)[1]

D. K. Biswas and J. K. Maheswari[2]

Introduction

Chaibasa situated between 22°5′ and 22°35′N and 85°20′ and 85°55′E is on the southern fringe of Chotanagpur plateau and composed of steep rocky hills, hillocks and intervening valleys, beside same areas which are plain. Geologically Chaibasa is one of the most important areas in the Singhbhum dist. of Bihar because of its mineral deposits. The soil in this locality is characteristically of the red soil type (Sandy loam to clay) formed on parent rocks occurring in these areas. They are acidic with pH varying from 5.0 to 6.5. The climate of the area is more or less similar to that of the district in particular and to Bihar in general with rainfall mostly being confined to monsoonic months, i.e. July-September. The average annual rainfall is about 142 cm with maximum fall during July-August. The hottest months in the year are May-June with mean maximum temperature of 43°C and coldest months are December-January with minimum temperature of 12°C.

Enumeration

In the following enumeration the system of Bentham and Hooker with some delimitations of families has been followed. Nomenclature has been, as far as possible, brought up to date. It may be noted that the following species were collected during the months of June-July 1975. The field number mentioned against the place of collection is indicative of the author's own contribution. The enumerated taxa have been deposited in the Central National herbarium, Shibpur, Howrah-3.

DICOTYLEDONS

Annonaceae

Annona squamosa Linn. Biswas 112.

Miliusa velutina Hook.f and Thoms. Biswas 201, 181.

Papaveraceae

Argemone mexicana Linn. Biswas 113.

Polygalaceae

Polygala chinensis Linn. Biswas 141, 144.

Dipterocarpaceae

Shorea robusta Gaertn. Biswas 182.

Meliaceae

Heynea trijuga Roxb. Biswas 171.

Olacaceae

Olax scandens Roxb. Biswas 124.

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[1] Accepted November 1977.

[2] Botanical Survey of India, Sibpur, Howrah-711 103.

CELASTRACEAE

Celastrus paniculata Willd. Biswas 214, 131.

VITACEAE

Ampelocissus latifolia (Roxb.) Planch. *Vitis latifolia* Roxb. Biswas 165.

SAPINDACEAE

Schleichera oleosa (Lour.) Oken, *S. trijuga* Willd. Biswas 163.

ANACARDIACEAE

Semecarpus anacardium Linn. Biswas 151.
Spondias pinnata (Linn. f.) Kurz. *S. mangifera* Willd. Biswas 108.

PAPILIONACEAE

Crotalaria prostrata Roxb. Biswas 129.
C. mucronata Desv. *C. striata* DC. Biswas 184.

CAESALPINIACEAE

Cassia fistula Linn. Biswas 163.
Delonix regia (Boj) Raf *Poinciana regia* Boj Biswas 118.

MIMOSACEAE

Acacia leucophloea Willd. Biswas 131.

COMBRETACEAE

Terminalia arjuna (Roxb. ex DC.) Wt. & Arn. Biswas 183, 131.
T. crenulata Roth *T. tomentosa* var. *crenulata* Clarke Biswas 189.
T. bellerica (Gaertn.) Roxb. Biswas 179.

LYTHRACEAE

Lagerstroemia parviflora Roxb. Biswas 175.
Woodfordia fruticosa (L.) Kurz. *W. floribunda* Salisb. Biswas 114.

ONAGRACEAE

Ludwigia adscendens (L.) Hara. *Jussiaea repens* L. Biswas 161.

SAMYDACEAE

Casearia elliptica Willd. *C. tomentosa* Roxb. Biswas 111, 177.

MOLLUGINACEAE

Glinus oppositifolius (Linn.) A. DC. *Mollugo spergula* Linn. Biswas 154.

RUBIACEAE

Mitragyna parvifolia (Roxb.) Korth *Stephegyne parvifolia* Korth. Biswas 213.
Oldenlandia paniculata Linn. Biswas 218.
Pavetta crassicaulis (Bremek.) *P. indica* auct. non Linn. Biswas 137.
Wendlandia tinctoria DC. Biswas 136.
Xeromphis spinosa (Thunb.) Keay *Randia dumetorum* Lamk. Biswas 221, 164.
X. uliginosa (Retz.) Mahesh. *Randia uliginosa* DC. Biswas 204.

COMPOSITAE

Emilia sonchifolia (Linn.) DC. Biswas 156.
Eclipta prostrata (Linn.) Linn. *E. alba* (Linn.) Hasak. Biswas 130.
Glossogyne pinnatifida DC. Biswas 139.
Vernonia cinerea (L.) Less. Biswas 196.

SAPOTACEAE

Madhuca indica Gmel. *Bassia latifolia* Roxb. Biswas 102.

EBENACEAE

Diospyros exsculpta Buch.-Ham. *D. tomentosa* Roxb. Biswas 219, 176.
D. cordifolia Roxb. *D. montana* Clarke Biswas 199.

OLEACEAE

Jasminum arborescens Roxb. Biswas 210.

APOCYNACEAE

Holarrhena antidysenterica (Roth.) A. DC. Biswas 126, 171.
Thevetia peruviana (Pers.) K. Schum. *T. neriifolia* Juss. Biswas 110.

GENTIANACEAE

Canscora decussata Roem. and Sch. Biswas 155.

BORAGINACEAE

Cordia myxa Linn. Biswas 107.
Heliotropium indicum Linn. Biswas 197.
H. ovalifolium Forsk. Biswas 140.

CONVOLVULACEAE

Volvulopsis nummularia (Linn.) Roberty *Evolvulus nummularius* Linn. Biswas 205.

SOLANACEAE

Solanum surattense Burm. f. *S. xanthocarpum* Schrad. and Wendl. Biswas 117.

SCROPHULARIACEAE

Lindernia verbenaefolia (Colsm.) Pennell *Bonnaya veronicaefolia* var. *verbenaefolia* Hook. Biswas 160.

ACANTHACEAE

Andrographis paniculata (Burm.) f. Wall. ex Nees Biswas 207.
Barleria cristata Linn. Biswas 193.
Ruellia tuberosa Linn. Biswas 202.

VERBENACEAE

Callicarpa arborea Roxb. Biswas 126.
Phyla nodiflora (L.) Greene. Biswas 135.
Vitex negundo Linn. Biswas 116.

LABIATAE

Leucas mollissima Wall. Biswas 145.
Pogostemon benghalense (Burm. f.) Ktze. Biswas 206, 147.

POLYGONACEAE

Polygonum barbatum Linn. Biswas 131.
P. plebejum R. Br. Biswas 115, 192.

EUPHORBIACEAE

Emblica officinalis Gaertn. *Phyllanthus emblica* Linn. Biswas 150.
Jatropha curcas Linn. Biswas 105.

MONOCOTYLEDONS

DIOSCOREACEAE

Dioscorea glabra Roxb. Biswas 182.

COMMELINACEAE

Commelina hasskarlii Clarke Biswas 183.

CYPERACEAE

Cyperus rotundus Linn. Biswas 184.
C. difformis Linn. Biswas 83.
Carex indica Linn. Biswas 85.
Fimbristylis dichotoma (Linn.) Vahl Biswas 87.

F. junciformis Kunth Biswas 91.

Fuirena ciliaris (L.) Roxb. syn. *F. glomerata* Lamk. Biswas 88|

Scripus articulatus Linn. Biswas 108, 89.

Scleria levis Retz. syn. *S. hebecarpa* Nees ex Wight Biswas 2.

POACEAE

Dichanthium aristatum (Poir) C. E. Hubb. Biswas 1.

Eragrostis tenella (Linn.) Beauv. ex Boem. and Schult. Biswas 95.

E. pilosa (L.) Beauv. Biswas 75.

Heteropogon contortus (L.) Beauv. Biswas 96.

Imperata cylindrica (L.) Beauv. var. *major* (Nees) Hubb. ex Hubb. and Vaughan Biswas 79.

Phragmites karka Trin. Biswas 101.

Pogonatherum paniceum (Lamk.) Hack. Biswas 3.

Polypogon manspeliensis (Linn.) Desf. Biswas 78.

Saccharum spontaneum Linn. Biswas 76.

Themeda quadrivalvis (L.). O. Ktze. Biswas 78, 79.

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BREEDING HABITS AND ASSOCIATED PHENOMENA IN SOME INDIAN BATS

Part VI — **Scotophilus heathi** (Horsefield) — Vespertilionidae[1]

A. Madhavan[2]

Scotophilus heathi (Horsefield) from Trichur, Kerala State, has an annual reproductive cycle. Copulation occurs during the second week of November and ovulation and fertilization by the stored spermatozoa occur in the last week of December. Every female in the colony conceives in December and young ones are delivered during the following April and the first week of May. Lactation continues until August. Animals are sexually quiescent during the rest of the year. The two uterine cornua are normally functional and carry an embryo each during each cycle. The gestation period varies in different animals from 100 to 130 days. The females far outnumber the males in the adult stage although at birth the sex ratio is even.

INTRODUCTION

Scotophilus heathi is one of the species chosen for detailed study under the project of studies on the breeding habits of Indian bats. This species has been chosen not only as a representative from an area from which the breeding habits of no bat has been so far reported but also because this species presents unusual features of reproduction. Detailed reviews of earlier literature on bat reproduction have been given (Gopalakrishna, 1947, 1948, 1949, 1955; Madhavan, 1971; Gopalakrishna and Choudhari, 1977; Gopalakrishna and Rao, 1977).

MATERIAL AND METHODS

Most of the specimens of *Scotophilus heathi* examined for the present study were collected from under the tiles of roofs of houses. A few specimens were also collected from under the leaves of palmyra trees, from the belfry of churches and on one occasion from a well. All specimens were collected in and around Trichur, Kerala (approximately 10°N., 76.3°E.). The animals were collected at frequent intervals commencing from April 4, 1971 and until February 5, 1978 except during the year 1974. Altogether 957 specimens were studied for the present report.

Scotophilus heathi is a large bat for a microchiropteran with an adult body weight of 36 to 39 g (the females attaining a higher weight than the males, a wing-span of *c.* 40.0 cm, forearm length of *c.* 6.5 cm, head length of *c.* 2.5 cm and ear pinna length of *c.* 1.5 cm. The specimens were collected from their roosts with the help of a pair of long forceps and after killing with chloroform they were weighed in a sensitive spring balance. Observations on the disposition of the external genitalia, mammary teats in the females, and po-

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[1] Accepted February 1978.

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sition of the testes in the males were recorded. The genital organs and the accessory structures were dissected out and fixed in different fixatives. After fixation for 24 hours the tissues were preserved in 70% alcohol. The tissues were dehydrated by passing through graded series of ethanol, embedded in paraffin and sectioned at thickness of 6 to 10 μ. The testes were uniformly cut at 10 μ. The sections were stained with Ehrlich's haematoxylin, counterstained with eosin and mounted in DPX.

The character of a group of specimens collected on a given calendar date is almost the same during the different years when the collections were made. Hence, in the following descriptions only the date and month are mentioned where pertinent except where the mention of the year has a special significance. A detailed collection diary was maintained with descriptions of individual specimens. Table 1 gives the summary of the collection diary and Table 2 gives the monthwise distribution of collections.

OBSERVATIONS AND DISCUSSION

1. GENERAL NOTES ON *Scotophilus heathi*

This species occurs in small groups of 5 to 15 specimens which lie huddled together. There may be several clusters of specimens occupying different locations in the same house. During April, May, June and July the males were sometimes found 'sitting' away from the females although in the same house. The animals emerge from their roosts a little before sunset and take a dive almost to the ground level before they take to the sky. They fly about near the roosting place for a considerable time before flying out to distant places. The roost is empty by about 7 o'clock in the evening. The suckling mothers leave the young ones in the roosts before flying out in the evening for foraging. The mother vigorously shakes her body and actively pushes the young from its hold to the mammary nipple. Several times during the night the adult specimens visit the roosts where the young ones are left behind. They finally return to the roosts a little before sunrise. The mothers carry away the young ones if the roost is disturbed and roost in some other place, often returning with the young ones to the old roost two or three days later. Day light is not an impediment for them to roost because they are found roosting in well-lit areas in the roofs of the houses. The young ones assume an oblique posture with the head towards the mother's head while sucking. The young ones with body weights of 24 g and below are not able to execute sustained flights, but fall to the ground after flying a few yards.

The adult specimen has brown fur on the dorsal surface and bright yellow fur on the ventral surface of the body. The juveniles have dark brown fur on the dorsal surface and yellowish grey fur on the ventral surface of the body. Several parous adults have brick red-yellow fur on the ventral surface of the body. *Scotophilus heathi* does not tolerate the presence of other species of bats in the roost. On a few occasions a specimen of *Pipistrellus mimus mimus* was introduced into a cage in which *Scotophilus heathi* specimens were present. But it was immediately attacked and killed by an adult *Scotophilus heathi*. No other species of bats could be found in the houses occupied by *Scotophilus heathi*. The specimens remain in partial torpidity during daytime throughout the year.

Although normally two young ones are delivered each time, there were a few instances when only one was produced. The newly born young is reddish in colour with naked skin and adherent eyelids. A pair of pectoral mammary glands are present, one on either side,

TABLE 1

SUMMARY OF COLLECTION DIARY

Date	Males				Females						Grand Total
	Immature		Adult	Total	Immature		Adult			Total	
	Attached	Free			Attached	Free	Non-pregnant	Pregnant	Lactating		
1	2	3	4	5	6	7	8	9	10	11	12
4-1-76	—	—	—	—	—	—	—	1	—	1	1
7-1-78	—	—	1	1	—	—	—	—	—	—	1
9-1-77	—	—	3	3	—	—	—	5	—	5	8
12-1-77	—	—	2	2	—	—	—	9	—	9	11
16-1-77	—	—	2	2	—	—	—	4	—	4	6
17-1-77	—	—	—	—	—	—	—	9	—	9	9
18-1-73	—	—	1	1	—	—	—	3	—	3	4
19-1-77	—	—	3	3	—	—	—	2	—	2	5
20-1-72	—	—	—	—	—	—	—	6	—	6	6
22-1-77	—	—	—	—	—	—	—	7	—	7	7
24-1-76	—	—	—	—	—	—	—	4	—	4	4
26-1-77	—	—	—	—	—	—	—	7	—	7	7
29-1-72	—	—	3	3	—	—	—	3	—	3	6
30-1-77	—	—	1	1	—	—	—	7	—	7	8
4-2-77	—	—	3	3	—	—	—	10	—	10	13
5-2-78	—	—	2	2	—	—	—	7	—	7	9
6-2-77	—	—	3	3	—	—	—	4	—	4	7
9-2-77	—	—	2	2	—	—	—	6	—	6	8
12-2-77	—	—	2	2	—	—	—	2	—	2	4
16-2-77	—	—	5	5	—	—	—	6	—	6	11
19-2-77	—	—	1	1	—	—	—	7	—	7	8
24-2-77	—	—	1	1	—	—	—	3	—	3	4
26-2-72	—	—	2	2	—	—	—	4	—	4	6
27-2-77	—	—	1	1	—	—	—	6	—	6	7
3-3-77	—	—	1	1	—	—	—	2	—	2	3
4-3-73	—	—	—	—	—	—	—	2	—	2	2
5-3-77	—	—	—	—	—	—	—	10	—	10	10
6-3-76	—	—	—	—	—	—	—	2	—	2	2
10-3-73	—	—	—	—	—	—	—	1	—	1	1
11-3-72	—	—	3	3	—	—	—	2	—	2	5
13-3-77	—	—	1	1	—	—	—	3	—	3	4
14-3-76	—	—	—	—	—	—	—	3	—	3	3
19-3-72	—	—	8	8	—	—	—	7	—	7	15
23-3-77	—	—	—	—	—	—	—	3	—	3	3
28-3-77	—	—	1	1	—	—	—	2	—	2	3
29-3-77	—	—	2	2	—	—	—	10	—	10	12
31-3-72	—	—	5	5	—	—	—	3	—	3	8

1	2	3	4	5	6	7	8	9	10	11	12
31-3-73	—	—	—	—	—	—	—	1	—	1	1
1-4-76	—	—	1	1	—	—	—	2	—	2	3
4-4-71	2	—	—	2	1	—	—	—	2	3	5
4-4-77	—	—	—	—	—	—	—	2	—	2	2
5-4-72	—	—	4	4	—	—	—	9	—	9	13
5-4-77	—	—	—	—	—	—	—	4	—	4	4
7-4-72	1	—	—	1	—	—	—	3	1	4	5
7-4-77	—	—	1	1	—	—	—	2	—	2	3
8-4-77	—	—	—	—	—	—	—	5	—	5	5
9-4-72	3	—	—	3	1	—	—	—	1	2	5
11-4-76	—	—	—	—	—	—	—	2	—	2	2
13-4-72	—	—	5	5	—	—	—	—	—	—	5
13-4-77	—	—	2	2	—	—	—	6	—	6	8
14-4-76	1	—	—	1	1	—	—	3	1	5	6
15-4-72	4	—	—	4	5	—	—	1	6	12	16
17-4-77	—	—	—	—	—	—	—	8	—	8	8
19-4-73	—	—	—	—	—	—	—	1	—	1	1
20-4-72	5	—	—	5	3	—	—	1	5	9	14
20-4-76	3	—	—	3	1	—	—	1	2	4	7
21-4-75	—	—	—	—	—	—	—	2	—	2	2
25-4-76	1	—	—	1	3	—	—	1	3	7	8
25-4-77	6	—	—	6	4	—	—	2	4	10	16
1-5-72	4	2	1	7	4	—	—	—	4	8	15
2-5-76	2	1	—	3	2	1	—	—	2	5	8
3-5-77	5	—	—	5	3	—	—	—	4	7	12
10-5-72	—	2	3	5	3	—	—	—	2	5	10
10-5-76	2	—	—	2	4	—	1	—	2	7	9
17-5-76	2	1	—	3	5	—	1	—	3	9	12
20-5-72	—	—	3	3	—	1	3	—	2	6	9
21-5-75	—	—	2	2	—	—	—	—	—	—	2
22-5-77	1	11	—	12	3	1	—	—	2	6	18
24-5-77	—	—	—	—	—	1	—	—	—	1	1
26-5-77	—	5	2	7	—	1	2	—	4	7	14
30-5-72	—	2	3	5	—	—	3	—	3	6	11
30-5-76	1	2	1	4	—	1	1	—	3	5	9
31-5-75	—	1	2	3	—	1	—	—	—	1	4
5-6-77	—	—	—	—	—	3	1	—	5	9	9
10-6-72	—	—	6	6	—	—	—	—	—	—	6
13-6-76	—	—	4	4	—	—	1	—	1	2	6
15-6-72	—	—	—	—	—	—	1	—	1	2	2
20-6-72	—	—	1	1	—	—	1	—	1	2	3
26-6-77	—	2	—	2	—	2	1	—	4	7	9
27-6-76	—	—	—	—	—	—	—	—	1	1	1
28-6-72	—	—	2	2	—	—	1	—	—	1	3
30-6-72	—	—	2	2	—	—	2	—	1	3	5
3-7-77	—	—	4	4	—	1	1	—	2	4	8

1	2	3	4	5	6	7	8	9	10	11	12
9-7-77	—	1	2	3	—	2	1	—	—	3	6
11-7-72	—	—	1	1	—	—	2	—	—	2	3
14-7-72	—	—	2	2	—	—	5	—	—	5	7
17-7-76	—	—	3	3	—	—	3	—	3	6	9
17-7-77	—	2	—	2	—	7	1	—	6	14	16
20-7-75	—	—	—	—	—	—	6	—	—	6	6
24-7-77	—	2	—	2	—	2	1	—	—	3	5
6-8-77	—	—	1	1	—	2	—	—	2	4	5
15-8-72	—	—	—	—	—	—	2	—	—	2	2
15-8-76	—	—	2	2	—	—	2	—	—	2	4
18-8-73	—	—	3	3	—	—	3	—	—	3	6
21-8-72	—	—	—	—	—	—	1	—	—	1	1
21-8-75	—	—	1	1	—	—	—	—	—	—	1
21-8-76	—	—	3	3	—	—	2	—	—	2	5
23-8-77	—	—	2	2	—	1	2	—	—	3	5
24-8-75	—	—	1	1	—	—	5	—	—	5	6
7-9-76	—	—	—	—	—	—	3	—	—	3	3
10-9-76	—	—	5	5	—	—	4	—	—	4	9
10-9-77	—	—	4	4	—	—	5	—	—	5	9
13-9-75	—	—	4	4	—	—	—	—	—	—	4
14-9-73	—	—	3	3	—	—	3	—	—	3	6
19-9-76	—	—	1	1	—	—	4	—	—	4	5
25-9-76	—	—	4	4	—	—	2	—	—	2	6
25-9-77	—	—	1	1	—	—	2	—	—	2	3
28-9-75	—	—	2	2	—	—	2	—	—	2	4
29-9-71	—	—	1	1	—	—	2	—	—	2	3
2-10-76	—	—	2	2	—	—	2	—	—	2	4
3-10-71	—	—	3	3	—	—	—	—	—	—	3
8-10-77	—	—	3	3	—	—	1	—	—	1	4
9-10-76	—	—	1	1	—	—	3	—	—	3	4
11-10-75	—	—	—	—	—	—	7	—	—	7	7
12-10-75	—	—	1	1	—	—	—	—	—	—	1
14-10-75	—	—	1	1	—	—	—	—	—	—	1
16-10-71	—	—	2	2	—	—	2	—	—	2	4
18-10-75	—	—	2	2	—	—	—	—	—	—	2
18-10-76	—	—	2	2	—	—	3	—	—	3	5
23-10-76	—	—	1	1	—	—	3	—	—	3	4
23-10-77	—	—	2	2	—	—	2	—	—	2	4
28-10-73	—	—	1	1	—	—	1	—	—	1	2
30-10-76	—	—	3	3	—	—	6	—	—	6	9
6-11-71	—	—	1	1	—	—	—	—	—	—	1
7-11-76	—	—	—	—	—	—	2	—	—	2	2
10-11-73	—	—	1	1	—	—	1	—	—	1	2
12-11-77	—	—	9	9	—	—	10	—	—	10	19
13-11-76	—	—	4	4	—	—	1	—	—	1	5
15-11-75	—	—	2	2	—	—	—	—	—	—	2

1	2	3	4	5	6	7	8	9	10	11	12
18-11-73	—	—	3	3	—	—	3	—	—	3	6
20-11-76	—	—	5	5	—	—	1	—	—	1	6
22-11-75	—	—	1	1	—	—	3	—	—	3	4
23-11-75	—	—	2	2	—	—	—	—	—	—	2
26-11-77	—	—	7	7	—	—	16	—	—	16	23
27-11-76	—	—	4	4	—	—	1	—	—	1	5
1-12-73	—	—	3	3	—	—	1	—	—	1	4
4-12-77	—	—	5	5	—	—	3	—	—	3	8
5-12-75	—	—	—	—	—	—	1	—	—	1	1
5-12-76	—	—	2	2	—	—	3	—	—	3	5
8-12-73	—	—	3	3	—	—	—	—	—	—	3
10-12-77	—	—	2	2	—	—	1	—	—	1	3
11-12-76	—	—	6	6	—	—	4	—	—	4	10
11-12-77	—	—	3	3	—	—	—	—	—	—	3
12-12-76	—	—	8	8	—	—	3	—	—	3	11
13-12-77	—	—	9	9	—	—	3	—	—	3	12
15-12-75	—	—	1	1	—	—	1	—	—	1	2
15-12-77	—	—	1	1	—	—	1	—	—	1	2
16-12-77	—	—	4	4	—	—	6	—	—	6	10
18-12-76	—	—	1	1	—	—	1	—	—	1	2
18-12-77	—	—	8	8	—	—	6	—	—	6	14
23-12-73	—	—	1	1	—	—	—	—	—	—	1
23-12-76	—	—	3	3	—	—	—	—	—	—	3
24-12-76	—	—	2	2	—	—	1	—	—	1	3
27-12-76	—	—	2	2	—	—	—	4	—	4	6
28-12-76	—	—	1	1	—	—	—	—	—	—	1
29-12-71	—	—	2	2	—	—	—	2	—	2	4
31-12-76	—	—	5	5	—	—	—	13	—	13	18
31-12-77	—	—	4	4	—	—	—	1	—	1	5

TABLE 2

MONTHWISE COLLECTION OF THE SPECIMENS

Month	Males	Females	Total
January	16	67	83
February	22	55	77
March	21	51	72
April	39	99	138
May	61	73	134
June	17	27	44
July	17	43	60
September	25	27	52
August	13	22	35
October	24	30	54
November	39	38	77
December	76	55	131
Total	370	587	957

and the mammary nipples are visible only after the first lactation.

2. BREEDING HABITS

The examination of table 1 shows that pregnancies as evidenced by the occurrence of bulbous uterine cornua are present only from about the first week of January to about the fourth week of April. The one female collected on January 4 showed unmistakable sign of pregnancy since there was a swelling in both the uterine cornua. Between January 4 and January 12 progressively there was a greater proportion of females with bulbous uterine cornua among the specimens collected on each date. All females collected between January 12 and April 4 had noticeably large conceptus in the uterine cornua and carried progressively advanced stages of development of the foetus.

Microscopic examination of the females revealed some interesting features. Some of the female specimens collected on November 12 had undergone copulation as evidenced by the fact that sperms were present in the uterus and the uterine end of the fallopian tubes. Their ovaries had follicles in the multilaminar condition, and one or two follicles showed the beginning of the formation of antral spaces. Sperms were present in the uterus and the uterine end of the fallopian tubes of all females collected on and after November 12 and up to December 27, thereby indicating that copulation had taken place in all the females. One female collected on December 27 had a four-celled egg in the uterus. Free early embryos in progressively advanced stages of cleavage were present in every female collected between December 27 and January 4.

These facts indicate that although copulation occurs as early as November 12, ovulation does not take place until about the last week of December (Gopalakrishna and Madhavan, 1978). Secondly, ovulation occurs in all the specimens within a sharply defined period in the last week of December and fertilization and pregnancy follow immediately.

Although every female collected during January, February and March was pregnant, and although progressively advanced stages of development of the embryos were present during the successive weeks after December 27 it was noticed that the size of the conceptus carried by different females collected on any given date during February to April varied. This indicates that the rate of embryonic development may not be the same in all the specimens.

The last batch of pregnant females could be collected on April 25 although pregnant females probably occur until May 3 as evidenced by the fact that newly delivered young ones were available until May 3. After this date there was not a single female which could be assigned to having delivered recently although vigorous efforts were made to collect specimens at frequent intervals. Evidently all females in the roost had delivered their young by May 3. Pregnancy was not found to occur in any other month of the year. The above facts show that *Scotophilus heathi* has an annual reproductive cycle confined to a sharply restricted period.

The first batch of postpartum mothers and newly born young ones was collected on April 4. The young ones weighed 5.5 to 6.0 g, and in each case the umbilical cord was still attached to the body, the eyelids were adherent and the body was devoid of hair. These characters taken along with the fact that the highest weight of the foetus was 5.0 g, indicates that they might have been born less than a day before. It was interesting to note that although all females undergo ovulation and become pregnant during the last week of December (and not a single non-pregnant female was collected after December 27 until April 4 during the six years when collections were made during these months) all deliveries in the colony do not occur at about the same time. After April 4, when the first batch of postpartum mothers were obtained in the year, progressively more females in a collection had delivered their young during the following days until April 25. It is very likely that a few deliveries occur after April 25 until May 3 as mentioned earlier. This fact is an additional evidence to indicate that the rate of embryonic development varies in the different specimens as otherwise all females should deliver within a short span of time since all females become pregnant in a sharply defined period in the last week of December. Evidently the duration of pregnancy varies between 100 to 130 days, calculating the minimum period of gestation as 100 days from the first day when early cleavage stage of the egg was noticed (December 27) to the date on which the first delivered young are collected (April 4) and 130 days as being the maximum period as calculated until May 3, when the last deliveries probably occurred, and allowing a margin of a couple of days on either side.

The sucklings are carried by their mothers at their breasts while they are in the roost or when they are disturbed when they fly away with the young attached to the breast. The first batch of weaned free young ones was collected on May 1. Assuming that these were the young ones delivered in the first batch (that is around April 4) it is evident that the young are suckled for about 24 to 28 days allowing a margin of a couple of days. All the mothers in the colony are free of their young by the end of May. However, the females continue to be in lactation until the first week of August.

From the foregoing account of the breeding habits of *Scotophilus heathi* the annual life of the adult female of this species can be recognized into the following periods: (1) period of sexual quiescence from about the second week of August until the first week of November; (2) period of copulation from the second week of November until the last week of December; (3) ovulation and fertilization during the last week of December; (4) pregnancy from the last week of December until about the first week of May; (5) lactation from about the first week of April until about the first week of August.

On comparing the breeding habits of this bat with those of other Indian bats, it is interesting to note that *Scotophilus heathi* resembles *Pipistrellus ceylonicus chrysothrix* (Gopalakrishna and Madhavan, 1971) in that the inseminated sperms remain viable and successfully fertilize the ova released several weeks later. It was earlier known that survival of inseminated spermatozoa is a characteristic feature present only in the bats living in cold and temperate climates (Gates, 1936; Folk, 1940; Wimsatt, 1942, 1944; Hiraiwa and Uchida, 1956). It is now evident that this phenomenon is also prevalent in several tropical bats (Medway, 1972; Gopalakrishna and Madhavan, 1978). *Scotophilus heathi* resembles most Indian bats in having a sharply restricted annual breeding cycle (Gopalakrishna, 1947, 1948, 1949, 1950; Ramakrishna, 1951; Ramaswamy, 1961; Madhavan, 1971; Gopalakrishna and Rao, 1977; Madhavan *et al.*, 1978; Gopalakrishna and Madhavan, 1978). Only a few Indian bats have been known to breed more than once a year (Gopalakrishna, 1954, 1955; Gopalakrishna *et al.*, 1975; Madhavan, 1978).

3. NUMBER OF YOUNG AND SYMMETRY OF THE FEMALE GENITALIA

Unquestionable indication of pregnancy as evidenced by the occurrence of bulbous uterine cornua was noticed in the females collected between January 4 and April 25. During this period altogether 245 pregnant females were collected. Out of these 219 had an embryo in each uterine cornu. There were 25 females having a single embryo each — 15 of these had the foetus in the right cornu and 10 in the left. One female carried two embryos in the right cornu of the uterus and the left had none. Examination of the ovary of the pregnant females revealed that a single corpus luteum was present in each ovary in the specimens having a single foetus in each uterine cornu. In the case of the specimen which had two embryos in the right cornu the right ovary had two corpora lutea and none in the left. Evidently, the two sides of the genitalia are symmetrical morphologically and physiologically, and each side is equally functional during each reproductive cycle.

4. GROWTH AND MATURITY

The growth of the body of the young one is rapid during the early life and the young animals weigh almost as much as the adults when they are about 5 months of age so that young ones cannot be distinguished from the adults on the basis of the size of the body after this age. Until the middle of September, that is up to the age of 4 to 5 months, the young ones of the year can be distinguished from the adults by their having dark brown fur on the back and grey fur on the belly. Older adults have invariably bright yellow fur on the ventral side in both sexes. Sexual maturity is attained by specimens of both sexes at the body weight of about 28 g. The young ones are attached to the mother's breasts for about 24 to 28 days. The highest weight of an attached young one was 23 g and the lowest weight of a naturally weaned free young one was 24 g. It is evident that the young ones become free from their mothers when they reach about this weight. The young ones grow rapidly and increase in their weight by well over four times (from 5.5 g to 24.0 g) during the sucking period. Several juvenile specimens were collected from the first week of June until the middle of September. Since the examination of the stomach contents of these animals revealed the absence of curdled milk it is evident that the juveniles do not visit the lactating females after May. The growth of the young one is not rapid through the months of August and September, but they gain weight during October, November and December. Hence, October onwards it is not possible to distinguish the animals born in the year from the adults on the basis of the size of the body. However, in the case of females the animals of the year can be recognized as they do not have well-developed nipples. Microscopic examination of the testes of specimens collected during October, November and December revealed that all the males exhibited spermatogenetic activity. All the females become pregnant during the last week of December. This indicates that sexual maturity is attained in both sexes in the year of their birth and when they are 5 to 6 months of age.

5. SEX RATIO

Out of a total of 957 specimens collected at random and at frequent intervals for over 6 years, there were 370 males and 587 females giving a sex ratio of 630 males per 1000 females. This should reflect the natural sex ratio in this species in the total population since there is no segregation on the basis of sex, age or season in this species. There were equal number of males and females among 86 young ones found attached to their mother's breasts. Evidently, there is a balanced sex ratio during early juvenile life, and the difference in the proportion of males to females in the adult period is due to larger mortality of the males during the adolescent period.

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REFERENCES

Folk, G. E. (1940): The longivity of sperms in the female bat. *Anat. Rec. 76*: 103-109.

Gates, W. H. (1936): Keeping bats in captivity. *J. Mammal. 17*: 268-273.

Gopalakrishna, A. (1947): Studies on the embryology of Microchiroptera. Part I — Reproduction and breeding seasons in the south Indian vespertilionid bat, *Scotophilus wroughtoni* (Thomas). *Proc. Ind. Acad. Sci. 26*: 219-232.

——— (1948): ———. Part II. Reproduction in the male vespertilionid bat, *Scotophilus wroughtoni* (Thomas). ibid. *27*: 137-151.

——— (1949): ———. Part III. Histological changes in the genital organs and the accessory reproductive structures during the sex-cycle of the vespertilionid bat, *Scotophilus wroughtoni* (Thomas). ibid.; *30*: 17-46.

——— (1950): ———. Part VI. Structure of the placenta in the Indian vampire bat, *Lyroderma lyra lyra* (Geoffroy). *Proc. Nat. Inst. Sci. India. 16*: 93-98.

——— (1954): Breeding habits of the Indian sheath-tailed bat, *Taphozous longimanus* (Hardwicke). *Curr. Sci. 23*: 60-61.

——— (1955): Observations on the breeding habits and ovarian cycle in the Indian sheath-tailed bat, *Taphozous longimanus* (Hardwicke). *Proc. Nat. Inst. Sci. India. 21*: 29-41.

——— & Choudhari, P. N. (1977): Breeding habits and associated phenomena in some Indian bats. Part I — *Rousettus leschenaulti* (Desmarest) — Megachiroptera. *J. Bombay nat. Hist. Soc. 74* (1): 1-16.

——— & Madhavan, A. (1971): Survival of spermatozoa in the female genital tract of the Indian vespertilionid bat, *Pipistrellus ceylonicus chrysothrix* (Wroughton). *Proc. Ind. Acad. Sci. 73*(1): 43-49.

——— DO ———

(1977): Breeding habits and associated phenomena in some Indian bats. Part III — *Hipposideros ater ater* (Templeton) — Hipposideridae. *J. Bombay. nat. Hist. Soc. 74*: (3): 511-517.

———

(1978): Viability of inseminated spermatozoa in the Indian vespertilionid bat, *Scotophilus heathi* (Horsefield). *Ind. J. Exp. Biol. 16*: 851-854.

——— ——— & Rao, K. V. B. (1977): Breeding habits and associated phenomena in some Indian bats. Part II — *Rhinolophus rouxi* (Temminck) — Rhinolophidae. ibid. *74* (2): 213-219.

———, Thakur, R. S. & Madhavan, A. (1975): Breeding biology of the southern dwarf pipistrelle, *Pipistrellus mimus mimus* (Wroughton) from Maharashtra, India. *Dr. B. S. Chauhan Commemoration volume*: 225-240.

Hiraiwa, Y. K. & Uchida, T. (1956): Fertilization in the bats, *Pipistrellus abramus abramus* (Temminck). III. Fertilizing capacity of spermatozoa stored in the uterus after copulation in the fall. *Sci. Bull. Fac. Sci. Kyushu Univ. 15*: 255-266.

Madhavan, A. (1971): Breeding habits of the Indian vespertilionid bat, *Pipistrellus ceylonicus chrysothrix* (Wroughton). *Mammalia 35*(2): 283-306.

——— (1978): Breeding habits and associated phenomena in some Indian bats. Part V. *Pipistrellus dormeri* (Dobson) — Vespertilionides. *J. Bombay nat. Hist. Soc.* 75 (2): 426-433.

———, Patil, D. R. & Gopalakrishna, A. (1978): — Part IV — *Hippohideros fulvus fulvus* (Gray) — Hipposideridae. ibid. 75 (1): 96-103.

Medway, Lord. (1972): Reproductive cycles in the flat-headed bats, *Tylonycteris pachypus* and *T.*

robustula (Chiroptera — Vespertilioninae) in a humid equatorial environment. *Zool. J. Linn. Soc.* 57: 33-61.

Ramakrishna, P. A. (1951): Studies on reproduction in bats — I. Some aspects of reproduction in the oriental vampires, *Lyroderma lyra lyra* (Geoffroy) and *Megaderma spasma* (Linn). *J. Mys. Univ.* 7: 1-41.

Ramaswamy, K. R. (1961): Studies on the sex-cycle of the Indian vampire bat, *Megaderma lyra lyra* (Geoffroy). *Proc. Nat. Inst. Sci. India 27*: 287-307.

Wimsatt, W. A. (1942): Survival of spermatozoa in the female reproductive tract of the bat. *Anat. Rec. 83*: 299-307.

——— (1944): Further studies on the survival of spermatozoa in the female reproductive tract of the bat. ibid. *88*: 193-204.

STUDIES ON THE INTRASPECIFIC VARIATIONS IN *TRITHEMIS FESTIVA* (RAMBUR) (ODONATA: LIBELLULIDAE)[1]

Mahabir Prasad[2] and Arun Kumar[3]

(With six text-figures)

INTRODUCTION

Like many other insects, variations within the species is common in order Odonata. These variation have been briefly studied and reported from time to time in different species of dragonflies. Asahina (1952-53), while studying the Odonata material collected from Nepal by Japanese Himalayan expedition has noted the variations within the different species, similarly Singh & Baijal (1954) in Western Himalaya dragonflies; Baijal & Agarwal (1955) in Madhya Pradesh dragonflies; Sahni (1965a, 1965b) in the Odonata of Kumaon hills; Raychaudhari *et al.* and Lahiri *et al.* (1970) in *Brachythemis contaminata* (Fabricius), *Diplacodes trivialis* (Rambur) and *Crocothemis servilia servilia* (Drury); Varshney & Guha (1972) in *Rhyothemis variegata variegata* (Linn.); Lahiri & Mitra (1972) in *Acanthagyna dravida* (Lief.); Kumar & Prasad (1976) in *Orthetrum garhwalicum* Singh & Baijal; Singh & Prasad (1976, 1977) and Prasad & Singh (1976, 1977) in Doon Valley and Corbett National Park dragonflies; Prasad (1976a, 1976b and in press) in Western Himalaya and Eastern Uttar Pradesh Odonata; Bose & Mitra (1977) in Rajasthan dragonflies and Lahiri (1977) in Manipur dragonflies studied and have made brief remarks on intraspecific variations. However, these records are only occasional variations in small number of specimens, no attempt has so far been made for detailed biometrical study of intraspecific variations in Indian dragonflies. During the course of Odonata collection over many years in Western Himalaya, we noted distinct pattern of intraspecific variation in *Trithemis festiva* (Rambur), a species fairly common throughout lesser Himalayan range. We noticed the occurrence of two distinct group of specimens large sized and small sized. Kiauta (1969) also reported the occurrence of small size specimen (♀) from Nepal and states that "its abdominal length amounts scarcely to 21 mm. and that of the hind wing to 27 mm." Keeping the above in view we made a detailed study of intraspecific variations in *Trithemis festiva* (Rambur) on the basis of material collected from various localities in Western Himalaya. The species is widely and commonly distributed throughout Indian sub-continent (Kiauta 1969). Adults are common on the wing from March-April to November; larvae occur in slow running marshy streams and near the weedy banks of rivers (Kumar 1972).

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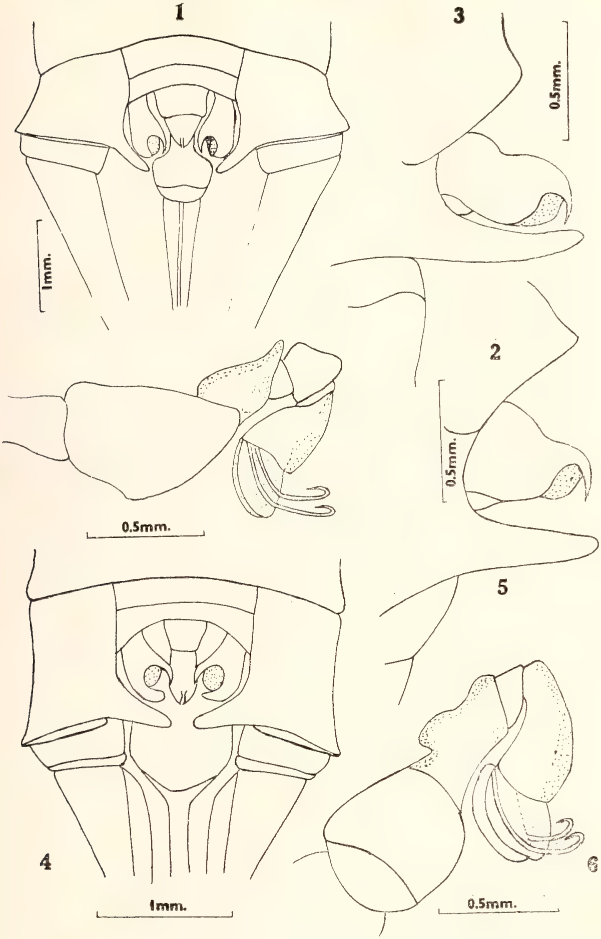

Figs. 1-3. Male accessory genital structures of large sized specimens of *Trithemis festiva* (Rambur): 1. Ventral view, 2. Lateral view, 3. Enlarged view of Prophallus and Vesicula spermalis.

Figs. 4-6. Male accessory genital structures of small sized specimens of *Trithemis festiva* (Rambur): 4. Ventral view, 5. Lateral view, 6. Enlarged view of Prophallus and Vesicula spermalis.

OBSERVATIONS

Male: (Refer Tables II, III & VI for various measurements)

Both large and small dragonflies, present at same localities, are violaceous black in colour. Head small in size, eyes contiguous, labium blackish brown in large size specimens while small size specimens it is black, some times yellowish brown. Labrum and mandibles black, anteclypeus black to yellowish brown, postclypeus dark olivacious brown to black, occiput dark brown to black. Eyes brown above and black beneath.

Prothorax dark blue to black, small posterior lobe is black, not fringed with hairs. Thorax narrow, black and coated with thin purplish pruinecence. Legs, long, black but hind femora with small closely set spines, and with a single set of long spines present on its distal end.

Wing hyaline, a dark opaque brown marking present only in hind wing of large size specimens, but in small size it is found both in fore and hind wings. The brown marking in the hind wing extends upto the subcosta, cubital space, beyond the cubital nervure and posteriorly beyond the membrane. In fore wing of small size specimens it extends upto the cubital space and posterior border of the wing. Reticulation close, and are situated between the 1st and 2nd antenodal nervurer, cubital nervure one, pterostigma black and cover 2 cells. Node nearer to pterostigma than base in both wings. Nodal index varies from $\frac{6\text{-}9\frac{1}{2}}{8\text{-}7}\Big|\frac{9\frac{1}{2}\text{-}5}{7\text{-}8}$ to $\frac{9\text{-}11\frac{1}{2}}{10\text{-}8}\Big|\frac{12\frac{1}{2}\text{-}8}{8\text{-}9}$ in large sized specimens, while $\frac{6\text{-}10\frac{1}{2}}{8\text{-}7}\Big|\frac{10\frac{1}{2}\text{-}6}{8\text{-}7}$ to $\frac{9\text{-}11\frac{1}{2}}{8\text{-}8}\Big|\frac{11\frac{1}{2}\text{-}9}{9\text{-}11}$ in small sized specimens. Discoidal cell in the fore wing narrow, its costal side just half of proximal side and traversed only once. Subtrigone 3-celled, sector of arc with a large fusion at its origin. Distal antenodal nervures incomplete, discoidal field begins with 3 rows of cells and is convergent at wing border. In hind wing discoidal cell entire, CUII arising from the posterior angle of discoidal cell. Discoidal field begins with 2 rows of cells. 2 rows of cells present in between IRIII & RSPL. Membrane dark brown and triangular in shape.

Abdomen 20.0-25.5 mm in length, black; anal appendages black.

Female: (Refer Tables IV, V & VI for various body measurements)

Labium yellowish-brown, its middle lobe black, labrum yellow and sides black. Ante and postclypeus yellow, face and frons yellowish brown, but some portion of upper sides of frons metallic blue. Upper portion of eyes brown and lower portion black, occiput black. Prothorax black, thorax yellow and marked with black, mid-dorsal carinal suture present upto the anterior sinus. Hamular stripe very thick, an inverted Y-shaped stripe present on the mesepimeron. The posterio—lateral suture short but oblique stripe ends across the metapimeron. Lower portion of the thorax yellow and marked with black stripe. Legs black, inner side of the anterior femora yellow, coxae and trochanter yellow.

Wings similar to the male, except the base of the hind wing which is marked with opaque brown marking upto the costal area, costal space and upto the cubital nervures and near the membrane. Nodal index varies from $\frac{8\text{-}10\frac{1}{2}}{8\text{-}7}\Big|\frac{11\frac{1}{2}\text{-}7}{8\text{-}9}$ to $\frac{9\text{-}12\frac{1}{2}}{9\text{-}8}\Big|\frac{10\frac{1}{2}\text{-}8}{8\text{-}9}$

Abdomen (20-23 mm in length) black and marked by yellow, dorsally, laterally and ventrally but its last three segments (8th, 9th and

10th) are totally black on the dorsum, marked with yellow and the lateral and ventral sides. And appendages black, long and acutely pointed at the tips.

TABLE I

SHOWING THE FREQUENCY OF SPECIMENS WITH BOTH SMALL AND LARGE SIZED SPECIMENS OF *Trithemis festiva* (RAMBUR) FROM DIFFERENT LOCALITIES IN WESTERN HIMALAYA.

Sl. No.	Locality	District	Large sized specimens		Small sized specimens	
			Male	Female	Male	Female
1.	Asarori	Dehra Dun	9	2	—	—
2.	Barkot	,,	4	—	—	—
3.	Dehra Dun	,,	1	—	—	—
4.	Donga	,,	15	6	2	1
5.	Herbertpur	,,	7	—	—	—
6.	Jaintanwala	,,	9	3	3	—
7.	Jhajra	,,	—	2	—	—
8.	Mianwala	,,	2	3	—	—
9.	Motichur	,,	12	2	4	—
10.	Rajpur	,,	23	1	4	3
11.	Rishikesh	,,	4	—	—	—
12.	Sahastra Dhera	,,	60	3	9	2
13.	Boxar (Corbett National Park)	Pauri Garhwal	8	2	4	1
14.	Dhikala (Corbett National Park)	,,	6	1	3	1
15.	Pauri	,,	10	3	2	1
16.	Deoprayag	Tehri Garhwal	2	—	—	—
17.	Tehri	Tehri Garhwal	10	—	—	—
18.	Chamoli	Chamoli	8	—	—	—
19.	Uttar Kashi	Uttar Kashi	3	1	—	—
20.	Bij Rani (Corbett National Park)	Nainital	20	4	3	—
21.	Haldwani	,,	3	—	—	—
22.	Kathgodam	,,	4	1	1	—
23.	Sultan (Corbett National Park)	,,	15	—	4	—
24.	Dhobighat (Ranikhet)	Almora	2	—	—	—
25.	Dwarson	,,	2	—	1	—
26.	Garli	Kangra	—	—	—	1
27.	Jhankaur	,,	—	2	—	—
28.	Jawalamukhi	,,	12	4	—	—
29.	Kangra	,,	2	4	4	2
30.	Mataur	,,	4	3	—	—
31.	Maranda	,,	—	—	2	—
32.	Ranital	,,	15	6	2	—

TABLE II

BODY MEASUREMENTS OF LARGE SIZED SPECIMENS OF *Trithemis festiva* (RAMBUR) (MALE)

S. No.	No. of specimens	Abdomen with anal appendages	Fore Wing	Hind Wing	Length in between base to node		Length in between node to pterostigma		Maximum width of hind wing	Pterostigma
					Fore Wing	Hind Wing	Fore Wing	Hind Wing		
1.	48	23.5 mm	32.5 mm	31.5 mm	17.00 mm	13.5 mm	11.00 mm	12.5 mm	11.00 mm	3.00 mm
2.	107	23.00 mm	31.5 mm	30.5 mm	16.5 mm	13.5 mm	10.5 mm	11.5 mm	10.00 mm	3.00 mm
3.	94 mm	23.5 mm	32.00 mm	31.00 mm	17.00 mm	14.00 mm	10.5 mm	12.5 mm	10.5 mm	2.5 mm
4.	23 mm	23.00 mm	32.00 mm	31.00 mm	17.00 mm	14.00 mm	11.00 mm	12.5 mm	11.00 mm	3.00 mm

TABLE III

BODY MEASUREMENTS OF SMALL SIZED SPECIMENS OF *Trithemis festiva* (RAMBUR) (MALE)

Sl. No.	No. of specimens	Abdomen with anal appendages	Fore Wing	Hind Wing	Length in between base to node		Length in between node to pterostigma		Maximum width of hind wing	Pterostigma
					Fore Wing	Hind Wing	Fore Wing	Hind Wing		
1.	8	21.5 mm	28.5 mm	27.00 mm	15.5 mm	12.5 mm	9.00 mm	11.00 mm	9.00 mm	3.00 mm
2.	14	21.00 mm	28.5 mm	27.5 mm	15.5 mm	12.5 mm	9.00 mm	10.5 mm	9.00 mm	2.5 mm
3.	2	21.5 mm	29.00 mm	28.5 mm	15.5 mm	13.00 mm	9.00 mm	11.00 mm	9.5 mm	3.00 mm
4.	3	22.00 mm	29.5 mm	29.00 mm	16.00 mm	13.00 mm	9.00 mm	11.00 mm	9.5 mm	2.5 mm
5.	6	20.00 mm	28.00 mm	26.00 mm	14.5 mm	13.00 mm	9.00 mm	10.5 mm	9.5 mm	2.5 mm
6.	1	20.5 mm	28.5 mm	27.5 mm	15.5 mm	12.00 mm	9.00 mm	10.5 mm	9.5 mm	2.5 mm
7.	11	21.00 mm	28.00 mm	27.00 mm	14.5 mm	12.00 mm	9.00 mm	10.5 mm	9.00 mm	2.5 mm
8.	3	20.5 mm	29.00 mm	28.00 mm	14.5 mm	12.5 mm	9.5 mm	11.00 mm	9.5 mm	3.00 mm

TABLE IV

BODY MEASUREMENTS OF LARGE SIZED SPECIMENS *Trithemis festiva* (RAMBUR) (FEMALE)

Sl. No.	No. of specimens	Abdomen with anal appendages	Fore Wing	Hind Wing	Length in between base to node		Length in between node to pterostigma		Maximum width of hind wing	Pterostigma
					Fore Wing	Hind Wing	Fore Wing	Hind Wing		
1.	8	22.5 mm	31.00 mm	30.00 mm	16.5 mm	14.00 mm	9.5 mm	11.5 mm	10.00 mm	3.00 mm
2.	6	22.5 mm	31.00 mm	30.00 mm	16.5 mm	13.5 mm	9.5 mm	11.00 mm	10.5 mm	3.00 mm
3.	12	22.5 mm	31.00 mm	30.00 mm	17.00 mm	13.5 mm	9.5 mm	12.00 mm	10.5 mm	3.00 mm
4.	7	23.00 mm	31.00 mm	30.00 mm	17.00 mm	13.00 mm	9.5 mm	11.5 mm	10.5 mm	3.00 mm
5.	18	22.5 mm	31.00 mm	29.5 mm	17.00 mm	13.00 mm	9.5 mm	11.5 mm	10.5 mm	3.00 mm
6.	1	23.00 mm	32.00 mm	31.00 mm	16.5 mm	13.00 mm	10.00 mm	12.00 mm	10.5 mm	3.00 mm

TABLE V

BODY MEASUREMENTS OF SMALL SIZED SPECIMENS OF *Trithemis festiva* (RAMBUR) (FEMALE)

Sl. No.	No. of specimen	Abdomen with anal appendages	Fore wing	Hind wing	Length in between base to node		Length in between node to pterostigma		Maximum width of hind wing	Pterostigma
					Fore Wing	Hind Wing	Fore Wing	Hind Wing		
1.	6	20.5 mm	29.00 mm	28.00 mm	15.5 mm	12.00 mm	9.00 mm	10.5 mm	9.5 mm	3.00 mm
2.	2	20.5 mm	29.5 mm	28.00 mm	15.00 mm	12.5 mm	9.00 mm	10.5 mm	9.5 mm	3.00 mm
3.	3	20.00 mm	28.00 mm	27.00 mm	15.00 mm	12.00 mm	8.5 mm	10.00 mm	9.5 mm	3.00 mm
4.	1	20.00 mm	28.00 mm	26.5 mm	14.5 mm	12.5 mm	8.5 mm	10.00 mm	9.5 mm	3.00 mm

TABLE VI

SHOWING VARIATION IN NODAL INDEX WITHIN THE LARGE AND SMALL SIZED SPECIMENS OF *Trithemis festiva* (RAMBUR)

Large Sized		Small Sized	
$\dfrac{6\text{-}9\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{9\frac{1}{2}\text{-}5}{7\text{-}8}$,	$\dfrac{7\text{-}10\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}7}{8\text{-}8}$,	$\dfrac{6\text{-}10\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{10\frac{1}{2}\text{-}6}{8\text{-}7}$,	$\dfrac{7\text{-}10\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}8}{7\text{-}8}$,
$\dfrac{8\text{-}9\frac{1}{2}}{10\text{-}7}\Big\vert\dfrac{9\frac{1}{2}\text{-}7}{7\text{-}7}$,	$\dfrac{7\text{-}11\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}7}{7\text{-}8}$,	$\dfrac{7\text{-}12\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}8}{8\text{-}9}$,	$\dfrac{7\text{-}10\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}7}{8\text{-}8}$,
$\dfrac{8\text{-}10\frac{1}{2}}{10\text{-}7}\Big\vert\dfrac{10\frac{1}{2}\text{-}9}{8\text{-}10}$,	$\dfrac{9\text{-}10\frac{1}{2}}{9\text{-}7}\Big\vert\dfrac{9\frac{1}{2}\text{-}8}{7\text{-}9}$,	$\dfrac{8\text{-}10\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{11\frac{1}{2}\text{-}7}{8\text{-}9}$,	$\dfrac{8\text{-}10\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{11\frac{1}{2}\text{-}8}{7\text{-}8}$,
$\dfrac{9\text{-}12\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}8}{8\text{-}9}$,	$\dfrac{8\text{-}10\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}8}{7\text{-}9}$,	$\dfrac{8\text{-}10\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}8}{8\text{-}10}$,	$\dfrac{8\text{-}11\frac{1}{2}}{10\text{-}7}\Big\vert\dfrac{11\frac{1}{2}\text{-}9}{7\text{-}10}$,
$\dfrac{9\text{-}11\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}9}{8\text{-}10}$,	$\dfrac{9\text{-}11\frac{1}{2}}{10\text{-}8}\Big\vert\dfrac{12\frac{1}{2}\text{-}8}{8\text{-}9}$.	$\dfrac{9\text{-}11\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}9}{9\text{-}11}$.	

TABLE VII

SHOWING VARIATION IN BODY MARKING OF BOTH LARGE AND SMALL SIZED *Trithemis festiva* (RAMBUR) COMPARED WITH THE PUBLISHED DESCRIPTION OF THE SPECIES

Sl. No.	Different parts of body	Large sized Specimen	Small sized specimen	Published description of the species
1.	Labium	Blackish brown	Black, sometimes yellowish brown Yellowish brown	Black
2.	Anteclypeus	Black	Black	Black
3.	Postclypeus	Dark olivaceous	Black	Dark olivaceous brown
4.	Occiput	Dark brown	Black	Black
5.	Prothorax	Dark blue	Some times a brown	Black
6.	Wing marking in male	Brown marking at the base of fore wing in male absent	marking at the base of fore wing in male present	Brown marking at the base of fore wing in male absent
7.	Nodal index	$\dfrac{6\text{-}9\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{9\frac{1}{2}\text{-}5,}{7\text{-}8}$ $\dfrac{9\text{-}12\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}8,}{8\text{-}9}$	$\dfrac{6\text{-}10\frac{1}{2}}{8\text{-}7}\Big\vert\dfrac{10\frac{1}{2}\text{-}6,}{8\text{-}7}$ $\dfrac{8\text{-}10\frac{1}{2}}{9\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}8,}{8\text{-}10}$	$\dfrac{8\text{-}9\frac{1}{2}}{8\text{-}8}\Big\vert\dfrac{10\frac{1}{2}\text{-}7,}{7\text{-}8}$ $\dfrac{9\text{-}11\frac{1}{2}}{10\text{-}8}\Big\vert\dfrac{11\frac{1}{2}\text{-}9}{8\text{-}10}$

DISCUSSION

Both large and small sized specimens of *Trithemis festiva* occur at same localities in Western Himalaya. The abdomen (along with anal appendages) of 272 examples of large sized male specimens varies from 23.00 mm to 23.5 mm, forewing 31.5 mm to 32.5 mm, hindwing 30.5 mm to 31.5 mm and pterostigma 2.5 mm to 3.00 mm. For detail of the other body measurements in male refer to Table II. 52 examples of large sized female specimens were studied, their abdomen (alongwith anal appendages) varies from 22.5 mm to 23.00 mm, forewing 31.00 mm to 32.00 mm, hindwing 29.5 mm to 31.00 mm, pterostigma 3.00 mm (for other body measurements kindly refer Table IV). Only 48 male specimens of small size were studied, and their abdomen (along with anal appendages) varies in between 20.00 mm to 22.00 mm, forewing 28.00 mm to 29.5 mm, hindwing 26.00 mm to 29.00 mm, pterostigma 2.5 mm to 3.00 mm. The 12 female specimens of small size have their abdomen (alongwith anal appendages) 20.00 mm to 20.5 mm, forewing 28.00 mm to 29.5 mm, hindwing 26.5 mm to 28.00 mm and pterostigma 3.00 mm (For other body measurements in male and female refer Tables III and V).

The large and small sized *Trithemis festiva* male and female are quite distinct from each other and can be easily separated from each other on the basis of their body measurements [the two type of specimens also have some differences in body colour and nodal index (refer Tables VI & VII)]. However, it is noticeable that large and small sized specimens are very close and similar to each other in their wing venation, body colour and male accessory genital structures (refer figs. 1-6). Thus the variations found in large and small sized male and female in their body measurements, wing venation, body colour are treated as intraspecific variations in *Trithemis festiva*.

ACKNOWLEDGEMENTS

We are thankful to the Director, Zoological Survey of India, Calcutta, for permission to carry out the present study. Our thanks are also due to Dr. B. S. Lamba, Deputy Director, Northern Regional Station, Zoological Survey of India, Dehra Dun, for various facilities.

REFERENCES

ASAHINA, S. (1952-1953): Fauna and flora of Nepal Himalaya Scientific results of the Japanese expeditions to Nepal Himalaya 1952-1953, Edited by H. Kihara. *Fauna and flora Res. Soc. Kyoto*, 291-300. (In Japanese)

BAIJAL, H. N. AND AGARWAL, J. P. (1955): Opuscula Libellulogica. *Agra Univ. J. Res. (Sci.)*, *4* (2): 453-470.

BOSE, G. AND MITRA, T. R. (1977): The Odonata fauna of Rajasthan. *Rec. zool. Surv. India*, *71* (1-4): 1-11.

FRASER, F. C. (1936): The Fauna of British India including Ceylon and Burma (Odonata) *3*: XI-461. Taylor and Francis, Ltd., London.

KIAUTA, B. (1969): Scientific results of the Yugoslav 1969 Himalaya expedition. *Bioloski vestinik*, *20*: 109-119.

KUMAR, A. (1972): Studies on the life history of *Trithemis festiva* (Rambur, 1842) (Odonata: Libellulidae). *Odonatologica*, *1* (2): 103-112.

KUMAR, A. AND PRASAD, M. (1976): On the occurrence of *Orthetrum garhwalicum* Singh & Baijal (Odonata: Libellulidae) in Kinnaur (Western Himalaya: Himachal Pradesh). *Newsl zool. Surv. India*, *2* (3): 94.

LAHIRI, A. R., MITRA, T. R. AND RAYCHAUDHURI, D. N. (1970): A note on *Crocothemis servilia servilia* (Drury) (Odonata: Libellulidae: Sympetrinae), *Sci. Cult., 36*: 334.

——— AND MITRA, T. R. (1972): A note on *Acanthagyna dravida* (Lieftinck) (Insecta: Odonata: Aeshnidae). *J. Bombay nat. Hist. Soc., 69* (2): 438-439.

——— (1977): On a collection of Odonata from Manipur with new records. *Rec. zool. Surv. India, 72* (1-4): 409-418.

MITRA, T. R. (1975): A review of Indian species of *Agriocnemis* Selys (Insecta: Odonata: Zygoptera: Coenagrionidae) with a note on *Agriocnemis nainitalensis* Sahni. *Dr. B. S. Chauhan Comm. Vol.*, 403-409.

PRASAD, M. (1976a): On the occurrence of *Urothemis signata signata* (Rambur) (Odonata: Macrodiplactidae) from Eastern Uttar Pradesh, India. *Newsl. zool. Surv. India, 2* (4): 142.

——— (1976b): Odonata of district Kangra (Himachal Pradesh). *Rec. zool. Surv. India 71* (1-4): 105-119.

——— (in press): Studies on the Odonata of Garhwal Hills. *Ind. J. Ent.*

——— AND SINGH, A. (1976): Odonata of Doon Valley 2. Zygoptera. *Rec. zool. Surv. India, 70* (1-4): 121-131.

RAYCHAUDHURY, D. N., LAHIRI, A. R. AND MITRA, T. R. (1969): A note on the distal antenodal nervure of *Brachythemis contaminata* (Fabricius) and *Diplacodes trivialis* (Rambur) (Insecta: Odonata: Libellulidae). *Sci. Cult., 35*: 220.

SAHNI, D. N. (1965a): Studies on the Odonata (Zygoptera) of Nainital. *Ind. J. Ent., 27*: 205-216.

——— (1965b): Studies on the Odonata (Anisoptera) of Nainital. *Ind. J. Ent., 27*: 277-289.

SINGH, A. AND PRASAD, M. (1976): Odonata of Doon Valley I. Anisoptera. *Rec. zool. Surv. India, 70* (1-4): 21-38.

——— (1977): Odonata (Insecta) of Corbett National Park (Uttar Pradesh, India). *J. Bombay nat. Hist. Soc. 73* (2) [1976]: 419-421.

SINGH, S. AND BAIJAL, H. N. (1954): Entomological Survey of the Himalaya II—on a collection of Odonata. *Agra Univ. J. Res. (Sci.), 3* (2): 385-400.

VARSHNEY, R. K. AND GUHA, M. (1972): A note on the wing marking of dragonfly *Rhyothemis variegata variegata* (L.) (Odonata: Libellulidae). *Patna Univ. J., 27*: 1-4.

PHYSICAL CHARACTERISATION OF THE SONG OF THE KOEL *EUDYNAMIS SCOLOPACEA*[1]

M. V. V. SUBRAHMANYAM
AND
R. V. KRISHNAMOORTHY[2]

(With four text-figures)

The koel *Eudynamis scolopacea* sings both in the morning and the evening. The morning song consists of 15 notes and the evening song 9 notes. As the note number increases, the frequency as well as the loudness of the song increases. Evening song usually contains high frequency notes. The frequencies range from 976 to 1818 Hz, which probably may be the reason for the mellowness of the song. When a recorded song was played to a singing koel, the latter stopped singing and sometimes quit its position. This suggests that the song reflects territoriality.

INTRODUCTION

Bird song usually refers to the loud and persistent vocalisations delivered seasonally by males in possession of a breeding or courting territory (Brockway 1969). The song probably stimulates the female's breeding behaviour and also aids in spacing breeding males (Marler 1956). The same song may unleash an attack by others when it is broadcast within the bird's territory (Weeds and Falls 1959, Falls 1969). The ontogeny of bird song and its seasonal effect has been worked out for many species (Allard 1930, Thorpe 1956, Nottebohm 1970, Panov *et al.* 1978). For the Indian Koel, the breeding season lasts from March to July (Lamba 1963); its habitat and parasitic nature has been well documented (Ali 1977, Hume 1890, Lamba 1969). However, no attempt has been made to characterise its song, although it is considered by some to be the pleasantest among the songs of common Indian birds. In the present study an attempt has been made to characterise the acoustic parameters of the daily song of the koel.

METHODS

Two Sennheiser MKH 805 directional microphones were placed 15′ (about 4.6 m) apart, on a tree top, which was identified earlier as being visited by the koel. The microphones were connected to a 5310 National Panasonic tape recorder, placed on the ground and 100′ away (30.5 m) from the tree. With such a set-up the song of the koel both in the morning (6-8 a.m.) and in the evening (4-5.30 p.m.) were recorded during the months April-June, 1979. Pre-recorded tapes were analysed for quality of notes of the songs using a Fourier Analyzer System (Hewlett-Packard). Note frequencies and song timings were obtained from the converter.

RESULTS

The morning song consists of 15 notes with a total duration of 40.96 s, and each note in

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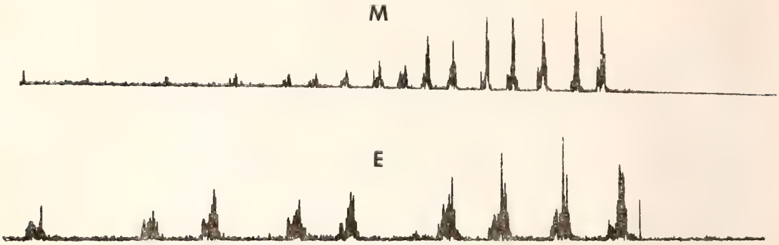
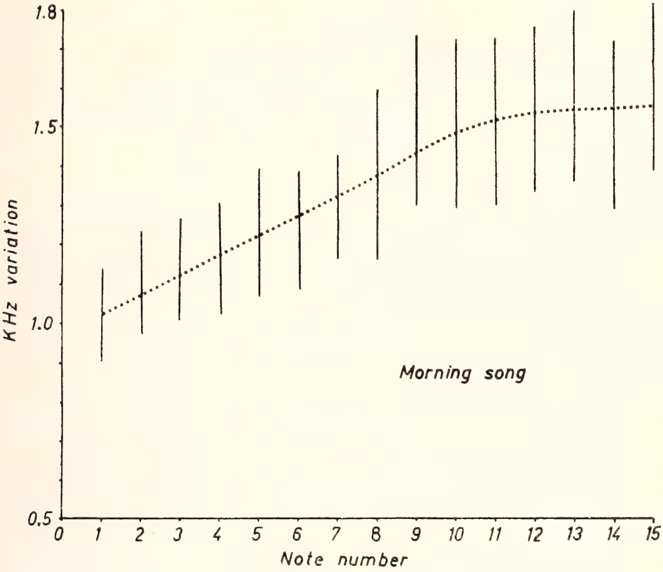


Fig. 1. Spectrograms of morning and evening songs of the koel. Horizontal axis denotes time in s and vertical axis represents loudness in millivolts.
Scale: M- x axis 1 cm 2.48 s; y axis 1 cm 2.1 mV
E- x axis 1 cm 1.2 s; y axis 1 cm 5 mV

the song is of 0.5 s duration. The evening song consists of 9 notes with a total duration of 20.48 s and a note duration of 0.6 s. Sometimes there were 14 notes in the morning song and 8 in the evening song. The internote period in both songs is not constant (Fig. 1). The song starts with low "kuoo", the loudness of which rises in scale gradually in both morning and evening songs (Fig. 1). The frequency of the sound at which the notes are delivered also varies as the notes proceed. In the morning song, as the note number increases the frequency gradually increases non-linearly. In the evening song there is linearity in the increase of frequencies as the notes are delivered (Fig. 2). The evening song invariably consists of higher frequencies (Fig. 2). The morning song starts with a frequency of 976-1218 Hz and ends with 1381-1818 Hz in the fifteenth note (Fig. 3). The evening song starts with 1200 Hz-1393 Hz and ends with 1243-1787 Hz. (Fig. 4). When the song reaches the final frequency the koel stops singing for some time and again resumes the song in the same frequencies. When a recorded song was played to a singing koel, it often stopped singing and sometimes quit its position.

DISCUSSION

The koel breeds during March-June in southern parts of India (Lamba 1969). The song of the koel can be heard in the same months and therefore, the coincidence of the song with season could be related to the breeding activity and the reproductive behaviour of the bird. It is also known that only the male koel sings till it mates (Lamba 1969). There is evidence that testosterone stimulates the mating behaviour of birds (Andrews 1964, Hamilton 1938, Hutchinson 1970). However, no correlations were made that the same hormone induced singing in birds. We tried in vain to check whether there were any behavioural responses in other koels of the surroundings when the tapes were played back, but the song has impact on the singing of a conspecific. When the recorded tape is played before a singing bird, the latter stops singing and flies away. This suggested that the song is purely territorial. Similar such territorial songs were noted in male chaffinches (Thorpe 1956).



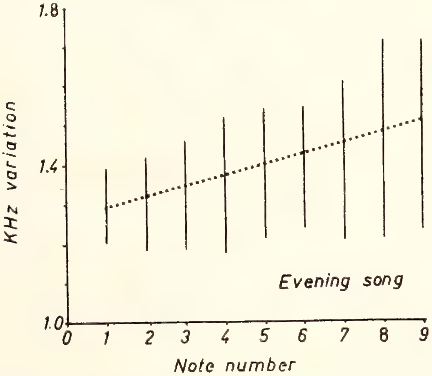


Fig. 2. Changes in frequencies in relation to the note number in morning and evening songs of the Koel.

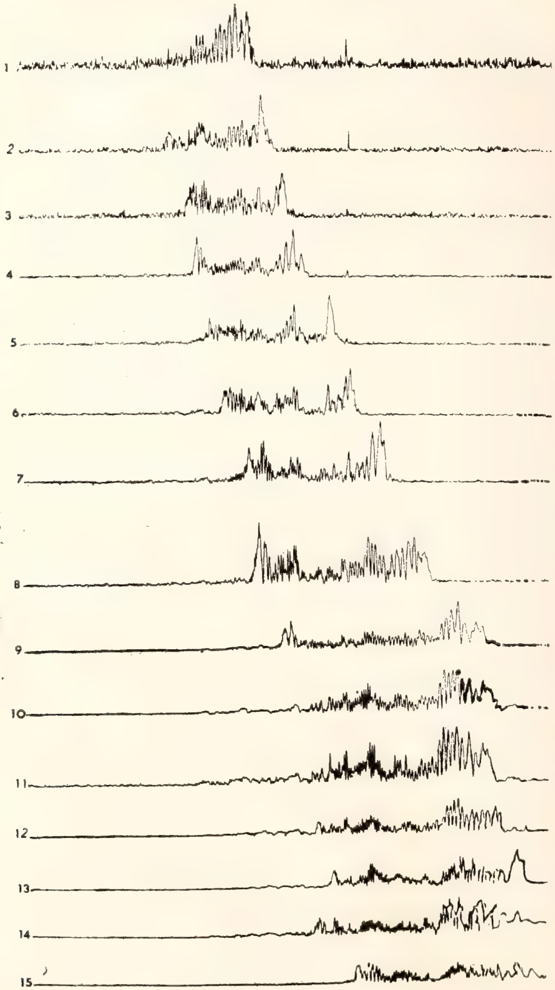


Fig. 3. Spectrograms of the notes of morning song of the Koel. Horizontal axis denotes the frequency in Hz and vertical axis represents loudness.
Scale: x axis 1 cm 62.5 Hz with 625 Hz as starting y axis 1 cm 2×10^{-2}V

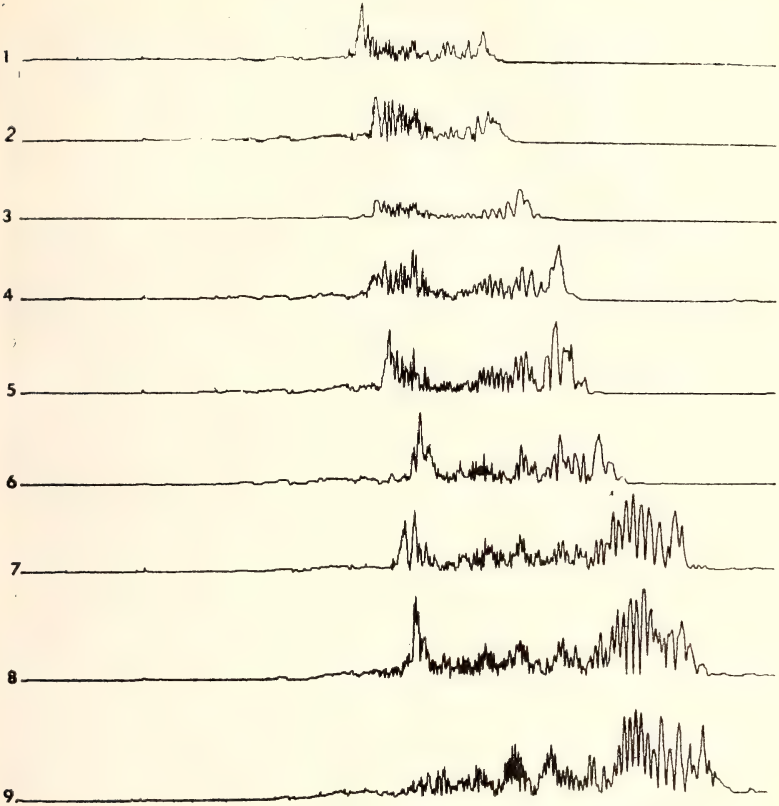


Fig. 4. Spectrograms of the notes of the evening song of the Koel Horizontal axis denotes frequency in kHz and vertical axis represents loudness.
Scale: x axis 1 cm 62.5 Hz with 625 Hz as starting point frequency
y axis 1 cm 2×10^{-2}V

Brockway (1969) suggested that the strength of the song and its persistence may be a measure of metabolism of the bird and climatic conditions at any particular place. This may be true for the difference in the number of notes observed in the morning and evening songs. Changes due to climatic conditions may be over ruled as there were not much variations in air temperatures between morning and evening in the present context. Correlations between climate and song (Allard 1930) was possible in the case of the dove which inhabits temperate lands. Probably the metabolism of the koel determines the shortness of the song in the evenings.

It is interesting to note that after the 9th note in morning song, the frequencies of the notes remained constant. Decrease in the note number in the evening song can be attributed to the physiological status of the bird. Exhaustion after a day's activity may decrease the note number.

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REFERENCES

ALI, S. (1977): The Book of Indian Birds. Bombay Natural History Society, Bombay.

ALLARD, H. A. (1930): The first morning song of some birds of Washington, D.C., its relation to light. *Am. Naturalist, 64*: 436-439.

ANDREWS, R. J. (1969): The effect of testosterone on avian vocalizations. In R. A. Hinde (ed.): Bird Vocalizations, Cambridge University Press.

BROCKWAY, B. F. (1969): Roles of budgerigar vocalisations in integration of breeding behaviour. In R. A. Hinde (ed.): Bird Vocalizations, Cambridge University Press.

FALLS, J. B. (1969): 'Function of the white throated sparrow', in R. A. Hinde (ed.): *Bird Vocalizations*, Cambridge University Press.

HAMILTON, J. B. (1938): Precocious masculine behaviour following administration of synthetic male hormone substance, *Endocrinology. 23*: 53-7.

HUME, A. O. (1890): Nests and eggs of Indian birds. Vol. 1, (Ed. R. H. Porter, London).

HUTCHINSON, J. B. (1970): Influence of gonadal hormones on the hypothalamic integration of courtship behaviour in barbary dove. *J. Rep. Fert. Suppl. 11*: 15-41.

LAMBA, B. S. (1963): The nidification of some common Indian birds. *J. Bombay nat. Hist. Soc. 60*: 121-123.

——— (1969): The nidification of some common Indian birds. *J. Bombay nat. Hist. Soc. 66*: 72-80.

MARLER, P. (1956): Behaviour of chaffinch, *Fringilla coelebs. Behaviour* sup. vol. 5.

NOTTEBOHM, F. (1970): Ontogeny of bird song. *Science, 167*: 950-956.

PANOV, E. N. KOSTINA, G. N. AND GALICHENKA, M. V. (1978): Song organisation in southern nightingale. *Zool., 57*(4): 568-581.

THORPE, W. H. (1956): The language of birds. *Scientific American, 195*(4): 128-138.

WEEDS, J. S. AND FALLS, J. B. (1959): Differential responses of male oven birds to recorded songs of neighbouring and more distinct individuals. *Auk. 76*: 343-351.

OBSERVATIONS ON THE REPRODUCTIVE BEHAVIOUR OF THE TIGER, *PANTHERA TIGRIS TIGRIS* LINN. IN CAPTIVITY[1]

ADHIR KUMAR DAS[2]

(*With a chart*)

INTRODUCTION

In view of the importance of tiger as one of the major endangered species in India a study of its reproductive behaviour is worth noting. This study was undertaken to provide information (i) on the reproductive behaviour of tiger, (ii) to ascertain the duration of oestrus, (iii) breeding season, (iv) gestation period, (v) percentage of pregnancies, (vi) litter size, (vii) sex ratio and (viii) the ratio of white and coloured cubs produced through crossing among coloured hybirds and between coloured hybrids and pure white tigers. This paper is based on data collected at the Calcutta Zoological Garden from 1965 to 1977.

MATERIALS AND METHODS

The Calcutta Zoological Garden has a good record of breeding of tigers in captivity. The first birth of tiger cubs at this Zoo took place in May, 1880 when three cubs were born. Two cubs were born in May, 1886 and two more cubs in April, 1889 (Sanyal 1892). Since then many tiger cubs have been born in this Zoo during the last several decades. Moreover, the acquisition of 3 white tigers (two pure white males from Maharaja of Rewa and one coloured female carrying gene for white, from Delhi Zoological Park) of the same litter in 1963 has improved much of its breeding potential. The tigers at Calcutta Zoo are kept in spacious enclosures and cages having sufficient space for exercise. Each cage or enclosure has a small den at the back where the tiger is shut in at night.

Tigers at Calcutta Zoo are fed six days in a week on beef and on Thursday no food is given. On average an adult tiger is given 12 kg of raw beef with and without bones daily. The ration of beef given to tigers ranges from 7 to 15 kg depending on the age, size, sex and general condition of the animals.

For the purpose of this study, data have been collected from my own observations from 1968 onward, supported by the records maintained at Calcutta Zoo in the form of daily report, birth and mortality registers etc. Mating behaviour of tigers have been recorded by me with assistance from some of my staff.

BREEDING SEASON

The tiger in India breeds all the year round and the cubs are born in any month of the year (Asdell 1946, Crandall 1964, Prater 1964, Schaller 1967, Ewer 1973).

At Calcutta Zoo the tigresses came in oestrus during all the months of the year. From 1965 to 1977, 48 oestruses or heat periods of seven tigresses had been recorded, and the females produced 61 cubs in 22 litters. This data is presented in Table 1.

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[1] Accepted May 1978.

[2] Zoological Garden, Alipore, Calcutta-700 027.

TABLE 1

BREEDING SEASON OF TIGER, *Panthera tigris tigris* IN CAPTIVITY

Months	Number of oestrus	Percentage	Number of litters born	Percentage
January	5	10.4	1 (2)	4.5
February	5	10.4	—	—
March	7	14.5	3 (9)	13.6
April	4	8.3	3 (9)	13.6
May	3	6.4	4 (12)	18.1
June	5	10.4	3 (8)	13.6
July	4	8.3	3 (10)	13.6
August	3	6.4	—	—
September	2	4.1	3 (8)	13.6
October	5	10.4	1 (1)	4.5
November	2	4.1	1 (2)	4.5
December	3	6.4	—	—
	48	100	22 (61)	100

The figures in the bracket indicate number of cubs.

TABLE 2

BREEDING RECORDS OF TIGER, *Panthera tigris tigris* IN CALCUTTA ZOO

Specimens	Number of oestrus periods	Range of oestrus periods (days)	Average oestrus periods (days)	Average of last day of oestrus to birth (days) Gestation period.	Average number of cubs/Litter
Malini	16	4—7	5.1	103	2 (7)
Chandni	14	3—7	5	104	3.2 (7)
Shashi	7	4—6	4.8	103	3.8 (5)
Sona	4	4—7	5.3	—	—
Rupa	3	6—9	7.3	—	—
Bharati	3	6—9	7.2	102	1.5 (2)
Moti	1	5	7	103	2 (5)
	48				

The figures in the bracket indicate number of litter.

Duration of oestrus:

The tigress in oestrus becomes restless and moves about very frequently and sometimes does not feed. Schaller (1967) reports that the tigress in oestrus squirts scent, sniffs, moans and roars in a low voice. The duration of oestrus was calculated on the basis of the total number of days for which the above mentioned behaviours of a tigress were recorded and when she permitted mounting and copulation by the male.

The data of oestrus periods as recorded in 7 tigresses in Calcutta Zoological Garden are shown in Table 2. The minimum interval between two consecutive oestruses was 26 days. Last oestrus phase was observed upto the age of 16 years in a tigress (Malini).

Sexual maturity:

Crandall (1964) reports that a tigress in New York Zoo reached maturity at 3 yrs. 8 months. Sankhala (1967) reports that tiger cubs attain maturity at an age between 3½ and 6 years. In captivity female lions become cyclic at 36 months of age (Crandall 1964). According to Stracey (1968) tigresses start to breed at the age of about three years. Tigresses in the wild reach sexual maturity at about four years of age, but in the abnormal conditions of captivity copulation has been observed as early as two and a half years (Mountfort 1973). Sexual maturity and birth of 1st litter in the case of six tigresses are shown in Table 3.

TABLE 3

OBSERVATION OF SEXUAL MATURITY OF TIGER, *Panthera tigris tigris*, AT CALCUTTA ZOO

Specimens	Date of birth	Date of first oestrus	Age at onset of oestrus	Date of birth of first litter	Age when first litter born
Malini	18.6.60	25. 2.65	4 yrs. 8 months	12. 6.65	4 yrs. 11 months
Chandni	12.6.65	2. 3.69	3 ,, 8 ,,	14. 7.69	4 ,, 1 ,,
Shashi	8.9.67	21. 7.72	4 ,, 10 ,,	24.11.72	5 ,, 2 ,,
Rupa	25.9.70	12. 3.75	4 ,, 5 ,,	—	— —
Sona	25.9.70	22. 3.74	3 ,, 11 ,,	—	— —
Bharati	10.6.66	10.10.70	3 ,, 6 ,,	24. 1.71	4 ,, 10 ,,

Mating behaviour:

Tigers and tigresses which are kept together, except at night, from very early age, breed freely in captivity but attempts to introduce new specimens to each other are not without risk of injury.

When a tigress comes in oestrus at Calcutta Zoo, a male tiger is put in the adjacent cage from where the two can see each other. At the advent of oestrus the tigress becomes restless, walks and sits frequently. While walking it moans and roars in low voice and squirts scent from its anal gland. She sits repeatedly in front of the wire-netted door of the adjacent cage where the male is confined. She sniffs at different places of the floor and wall and on seeing the male in the adjacent cage she produces a purring sound.

Courtship:

When the door of the adjacent cage is opened, the tigress hurriedly rushes into the adjacent cage and proceeds to the male very cautiously, sniffs the male producing puffing sound. If the male is in mood for mating he responds with a purring noise. If the male is not in a mood for mating a fight may occur and the couple have to be separated. It is seen that after fighting on the first day of oestrus, the male may accept the female the next day. When mutual confidence is established, the female approaches the male, purrs, rolls on her back on the ground in front of the male and pats at him playfully. The male sniffs the genitalia of the female, purrs and squirts scent frequently. He follows the female when she walks with lashing tail and starts playing with her. Mountfort (1973) states that the prelude to mating is accompanied by periods of play and harmless sparring which help to reduce the normal antagonism between sexes.

Copulation:

The tigress sometimes comes very close to the male and rubs her head, body and mouth to the head, body and mouth of the male. She sometimes lies on her belly stretching her forelimbs fully on the ground and her hind limbs remaining half bent. The male approaches from behind the female and arches his back, bringing his penis in contact with the genital region of the female. At this time the female begins to tread by pushing against the floor with her hind legs and when vaginal contact is made she bends her tail sharply to one side exposing her genital region and at the same time she turns her hind end in the direction of the stimulus. The male then holding the scruff of the neck of female by his teeth begins a series of vigorous pelvic thrusts at the female's urinogenital sinus. Intromission of penis is signalled by a loud copulatory cry from the female and a tremendous roar is produced by the male as he presses his genital region tightly against that of female. Ejaculation occurs during this interval. The actual time of coition varies from 7 to 10 seconds. The female then pulls forward, turns abruptly on the male, hisses and paws him and throws him off her back. Sometimes fighting takes place between the sexes inflicting scratch wounds. There may be unsuccessful attempts at mounting prior to successful mating.

Post copulatory behaviours:

After each copulation the male moves away from the female and walks about in the enclosure or usually lies on the ground. Sometimes he passes stool and urine and in some cases drinks water. The female tigress after copulation rolls on the ground and sometimes goes to the water for bathing. It is seen that the female goes to water at 3 to 5 times a day during her heat period.

After a short interval, the female again approaches the male and the whole process of courtship and copulation is repeated. With repeated copulations, initiative and eagerness of mating are seen more in the female than the male. The tigress proceeds to the male, rubs her head, body with the male and makes purring sound and sits in front of the male in the mating posture inviting him to mount. The entire process of copulation lasts for 1 to 3 minutes.

In Calcutta Zoo tigers are allowed to mate from 7 a.m. to 10-30 a.m. in the morning and again at 2.30 p.m. to 5 p.m. in the afternoon, i.e. for 6 hours per day. The duration of mating period as observed during 48 heat periods was from 3 to 9 days and average heat period was 5—9 days. The range of mating was from 2 to 52 times per day and the averags per day was 22.2 times. The minimum interval between two consecutive matings was 1 minute and maximum was 90 minutes and the average interval was 7.1 minutes. The highest number

TABLE 4

OBSERVATION OF MATINGS OF TIGER, *Panthera tigris tigris* AT CALCUTTA ZOO

Matings between	Number of heat period	Duration of heat period (days)	Average heat period (days)	Range of matings per day (in 6 hrs)	Average matings per day in 6 hours	Average interval between two consecutive matings (in minutes)	Highest number of matings in a single heat period	Lowest number of matings in a single heat period
Malini × Neeladri	16	4—7	5.1	5—52	25.1	7.3	235	66
Chandni × Himadri	12	3—6	4.9	2—45	20.4	4.9	171	20
Chandni × Bhanu	2	4—7	5.5	4—44	23.9	5.3	174	89
Rupa × Barun*	2	7—9	8	3—25	17.1	12.9	152	122
Shashi × Rabi	7	4—6	5	7—49	25.8	6.9	167	27
Rupa × Arun*	1	6	6	12—26	19.5	6.9	117	—
Sona × Bhanu*	4	6—8	6.4	10—48	25.1	7.8	206	126
Bharati × Johny*	3	6—9	7.3	10—47	26	5.6	247	170
Moti × Bhanu	1	5	5	9—35	18.4	6.7	92	—

* Indicates the pair of tigers which lived together except at night.

of matings observed in a single heat period was 235 times and the lowest was 20 times (Table 4).

Gestation period:

The gestation period of tiger is given as 105 to 109 days by Asdell (1946). Crandall (1964) records the gestation period as 100 to 108 days. Stracey (1968) records the gestation period as 15 to 16 weeks. Schaller (1967) reports the gestation period of tiger as 95 to 107 days. Ewer (1973) shows the gestation period of Indian tiger as 95 to 109 days. It is difficult to compare the above data, as in most cases the date of conception is defined differently. Crandall (1964) shows the gestation period of a tigress from the last observed mating as 100 to 108 days.

The duration of gestation period in the present observation has been estimated as the period from last day of mating to birth and the mean period was 103 days and the maximum and minimum were 107 and 101 days respectively.

Percentage of pregnancies:

The tigress does not become pregnant after matings in each heat period. In Calcutta Zoo, 7 tigresses mated with the males in 48 heat periods from 1965 to 1977. Out of 48 mating or heat periods pregnancy occurred in 22 cases and did not occur in 26 cases. The percentage of pregnancy is therefore 45.8% only and non-pregnancy is 54.2%. (Table 5). It was observed that the number of heat periods and percentage of pregnancy were less when both sexes lived together except at night.

TABLE 5

RECORDS OF THE PERCENTAGE OF PREGNANCY AND NON-PREGNANCY OF TIGER, *Panthera tigris tigris*, IN CALCUTTA ZOO

Mating between (specimens)	Number of mating or heat period.	Number of pregnancy	Percentage	Number of non-pregnancy	Percentage
Malini × Neeladri	16	7	43.7	9	56.3
Chandni × Himadri	12	6	50	6	50
Chandni × Bhanu	2	1	50	1	50
Shashi × Rabi	7	5	71.4	2	28.6
Bharati × Johny*	3	2	66.6	1	33.4
Moti × Bhanu	1	1	100	—	—
Rupa × Arun*	1	—	—	1	100
Rupa × Barun*	2	—	—	2	100
Sona × Bhanu*	4	—	—	4	100
	48	22	—	26	—

* Indicates the pair of tigers which lived together except at night.

Litter size:

Asdell (1946) records that the size of the litters varies from one to six but usually two to three cubs are produced. Schaller (1967) shows that the size of the litters varies from 1 to 7. Ewer (1973) reports that range of litter size is from 1 to 4 but 2 to 3 cubs are usually produced. Schaller (1967) shows the average size of 79 litters of tiger cubs born in Zoos as 2.8.

Data of 22 litters of tiger cubs at Calcutta

Zoo indicate that one cub per litter was on three occasions, two on nine occasions, four on eight occasions, three on one occasion and five cubs were born on one occasion. Average number of cubs per litter was 2.6 and the range of cubs per litter was 1 to 5 (Table 6 and Genealogical chart of white tigers).

TABLE 6

LITTER SIZE AND SEX RATIO OF TIGER, *Panthera tigris tigris*, IN CALCUTTA ZOO

Specimens	Litter Size			Sex Ratio	
	Total number of litters	Number of cubs in litter	Average number of cubs in litter	Male	Female
Malini	7	1—4	2.0	8	6
Chandni	7	2—4	3.2	8	15
Shashi	5	2—5	3.8	7	12
Bharati	2	1—2	1.5	1	2
Moti	1	2	2	1	1
	22			25	36

Sex ratio:

Thirty two tiger cubs were born in eleven litters to one tigress from 1948 to 1959 at New York Zoological Park, the divisions of sexes being nineteen males and thirteen females (Crandall 1964). According to Schaller (1967) the sex ratio of 196 tiger cubs at birth in various Zoological Gardens was 100 males and 100 females. Acharjyo and Mohapatra (1977) reported that 18 tiger cubs were born from 1960 to 1975 in Nandan Kanan Biological Park, Orissa of which 6 were males and 12 were females with a sex ratio of 50 : 100.

In Calcutta Zoo five tigresses gave birth to 61 cubs from 1965 to 1977 in 22 litters, the divisions of sexes being 25 males and 36 females. The ratio of male and female cubs was 100 : 144 (Table 6).

Ratio of white and coloured cubs:

In Calcutta Zoo 56 cubs were born out of crossing between pure white tigers with coloured hybrids, among pure whites, among coloured hybrids and between pure white and pure coloured tigers. Fourteen cubs were born

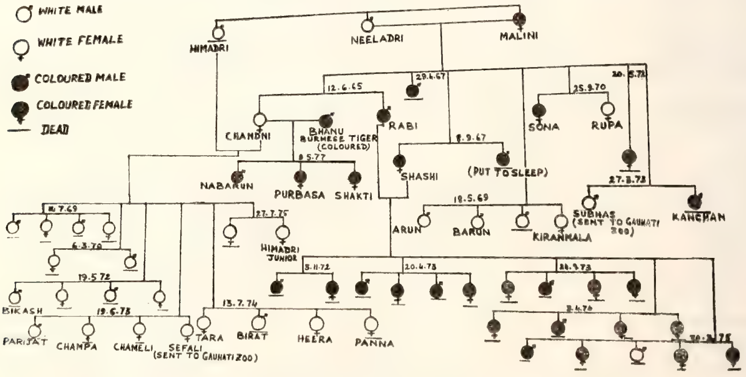
WHITE MALE
WHITE FEMALE
COLOURED MALE
COLOURED FEMALE
DEAD
HIMADRI
NEELADRI
MALINI
12.6.65
29.4.67
20.5.72
25.9.70
CHANDNI
BHANU BURMESE TIGER (COLOURED)
RABI
SONA
RUPA
8.9.67
8.5.77
NABARUN
PURBASA
SHAKTI
SHASHI
(PUT TO SLEEP)
27.3.73
7.69
27.7.75
18.5.69
SUBHAS (SENT TO GAUHATI ZOO)
KANCHAN
ARUN
BARUN
KIRANMALA
6.3.70
HIMADRI JUNIOR
3.11.72
20.4.73
19.5 72
BIKASH
19.6.73
13.7.74
PARIJAT
CHAMPA
CHAMELI
SEFALI (SENT TO GAUHATI ZOO)
TARA
BIRAT
HEERA
PANNA
3.4.76
30.3.75

Chart. Genealogy of white tiger *Panthera tigris tigris*, at Calcutta zoo.

to Malini (coloured hybrid female) being crossed with Neeladri (pure white male). The ratio of white and coloured cubs was 7 : 7. Twenty cubs were born to Chandni (pure white female) being crossed with Himadri (pure white male). All cubs were white. But Chandni when crossed with Bhanu (pure coloured Burmese male tiger) produced 3 coloured cubs. Nineteen cubs were born to Shashi (coloured hybrid female) being crossed with Rabi (coloured hybrid male). The ratio of white and coloured cubs was 1 : 18 (Genealogical chart of white tiger).

Discussion and conclusion

Tigers mate throughout the year and cubs are produced during all seasons in captivity although there are peak periods of matings and births. High percentage of mating took place in the month of January, February, March, April, June and October and mating percentage is low in other months of the year. High percentage of birth occurred in March, April, May, June, July and September. These correspond to the high breeding activities in the month of January, February, March, April, June and October. In the month of February, August and December not a single cub was born. These correspond with low breeding activities in the month of November, September and May.

The variations in the peak period of birth and mating may be due to climatic condition and other conditions in captivity.

All Felidae appear to be polyoestrus in tropics (Asdell 1946, Crandall 1964, Prater 1964). Crandall (1964) shows that the receptivity of tigress lasts about 5 days on average. Sankhala (1967) states that the mating period of the tiger ranges from 3 to 23 days. Schaller (1967) reports the average length of receptivity of 14 oestrus periods as 7.1 days. At Calcutta Zoo the duration of 48 oestrus periods of 7 tigresses ranged from 3 to 9 days and the average length of oestrus was 5.9 days. The variations in oestrus periods may be due to age, physical condition and frequency of copulation. Last oestrus phase was observed in a tigress (Malini) upto the age of 16 yrs. This suggests that menopause starts in a tigress after 16 years. It needs further verification.

There is much individual variations in the age at which the tigresses become sexually mature. It appears that tigresses attain sexual maturity at ages between 3½ to 5 years. But no clear conclusion can be drawn from these small examples.

The compatible pair of tigers mate freely in captivity but there is a chance of serious injury in first meeting. It can be seen from the Table 4 that the range of mating period is greater in case of tigresses which live together with the males in captivity. It may be due to the fact that the females are with the males at the vary beginning of oestrus or heat period. The average heat period of tigress in captivity is 5.9 days and the average matings per day is 22.2 times.

The range of gestation period of four tigresses in 22 litters was from 101 to 107 days with an average of 103 days. These data compare well with the gestation period given by other authors (Asdell 1946, Crandall 1964 and Ewer 1973).

The tigress does not become pregnant after matings in each heat period in captivity. The data of pregnancy show that out of matings in 48 heat periods, pregnancy occurred in 22 cases and did not occur in 26 cases. The percentage of pregnancy was 45.8% and non-pregnancy was 54.2%. It is not known whether the age, physical condition, range of mating period and number of matings in each heat period of a tigress have any role in pregnancy.

Crandall (1964) reported that the average number at birth of tiger cubs at London Zoo in 17 litters was 2.3 per litter. In Calcutta Zoo, the range of tiger cubs per litter was from 1 to 5 with an average of 2.6 cubs per litter. Usually 2 or 4 cubs were born in Calcutta Zoo. It seems probable that condition of health, availability of food, and stress and strain in Zoo condition have some role in litter size of a tigress.

The sex ratio of tiger cubs at birth varies widely. The ratio of male and female cubs born in Calcutta Zoo from 1965 to 1977 was 100: 144.

Genealogical chart of white tigers shows that the ratio of white and coloured cubs produced in a crossing between pure white male with coloured hybrid female is 7 : 7. The pure white female when crossed with pure white male produces all white cubs and pure white female when crossed with pure coloured male produces all coloured cubs. All these data are in conformity with the laws of inheritance. The data of crossing between coloured hybrid female with coloured hybrid male are yet to be observed.

The tigers' adaptibility, wide range in choice of habitat and above all its remarkably short gestation period suggest that under favourable condition it can survive well.

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REFERENCES

ASDELL, S. A. (1946): Patterns of Mammalian Reproduction. Ithaca, New York. Comstock Publishing Co. Inc.

ACHARJYO, L. N. & MOHAPATRA, S. (1977): Sex ratio at birth in some captive wild mammals. *J. Bombay nat. Hist. Soc. 74*: 167-169.

CRANDALL,, L. S. (1964): Management of Wild animals in Captivity. London & Chicago, The University of Chicago Press, The University of Toronto Press, Toronto-5, Canada.

EWER, R. F. (1973): The Carnivores. Weidenfeld & Nicolson, London W1.

MOUNTFORT, G. (1973): Tigers. David & Charles (Holdings) Ltd., South Devon House, Newton Abbot. Devon.

PRATER, S. H. (1964): The Book of Indian Animals. Bombay Natural History Society, Bombay.

SANYAL, R. B. (1892): A Hand Book of the Management of Animals in Captivity in Lower Bengal. Bengal Secretariat Press, Calcutta.

SCHALLER, G. B. (1967): The Deer and the Tiger. The University of Chicago Press, Chicago & London. The University of Toronto Press, Toronto-5, Canada.

SANKHALA, K. S. (1967): Breeding behaviour of Tiger in Rajasthan. *Int. Zoo Yb. 7*: 133-147.

STRACEY, P. D. (1968): Tigers. Arthur Barker Limited, 5, Winsley Street, London W1 & Golden Press, New York.

PRELIMINARY OBSERVATIONS ON THE STATUS OF SILVER CARP IN RELATION TO CATLA IN THE CULTURE FISHERY OF KULGARHI RESERVOIR[1]

S. J. Karamchandani[2] and D. N. Mishra[3]

(*With two text-figures*)

INTRODUCTION

The Chinese carp, *Hypophthalmichthys molitrix* (C.&V.), popularly known as silver carp, is an exotic fish introduced into India from Japan in September 1959. It is native to Chinese rivers, but has been introduced into almost all the South-east Asian countries. The work carried out at the Pond Culture Division of Central Inland Fisheries Research Institute, Cuttack has shown that silver carp is a fast growing fish, growing faster than catla and that its growth in Indian waters is faster than in its native waters. The observations further indicated that though the production of silver carp alone in a pond is over double that of catla, the presence of both in a pond seems to affect the growth of either adversely (Alikunhi and Sukumaran 1964). With this background, a small consignment of silver carp fingerlings was stocked in Kulgarhi reservoir on experimental basis on 11-2-1969. Based on the recovery of 8 specimens of silver carp (size range: 575-794 mm) from Kulgarhi reservoir during the period 2.12.69 to 4.6.71, Rao and Dwivedi (1972) have reported excellent growth of this exotic fish, thus indicating a great promise for the increased fish production from the reservoir. However, in a separate study, the comparison of growth rates of silver carp and catla from Kulgarhi reservoir has indicated that the culture of silver carp with catla in the reservoir adversely affects the growth of the latter. It is well known that the food habits of a fish have a direct bearing on its growth and survival. With a view to evaluate the status of silver carp in culture fishery of the reservoir with particular reference to catla, the observations were made on the food habits and the growth of silver carp and catla from Kulgarhi reservoir during the period 2.12.1969 to 22.12.1972 and the results thereof are reported in this communication.

Kulgarhi Reservoir:

It is situated about 85 km from Rewa in Nagod Tahsil, Satna District, Madhya Pradesh near Kulgarhi village, its geographical location being 80° 44′ 0″E longitude and 24° 28′ 50″N latitude.

The work on the construction of the reservoir was started in the year 1959 and completed in the year 1966. On the north of it, an earthen dam having a length of 1450 m and maximum height of 18.6 m has been constructed across a seasonal stream called Durha

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nalah (Ganga river basin), which originates from hills surrounding the reservoir on east, south and west sides and drains rain water from the catchment area of 10.69 sq. miles into the reservoir from south-west corner. The waste weir is located on the north-east side of the reservoir. The maximum water spread area is 193.5 hectres which was attained for the first time during 1971 monsoon season. The live storage capacity of the reservoir is 306 mc ft., whereas its dead storage capacity is only 26 mc ft.

MATERIAL AND METHOD

The construction work of Kulgarhi reservoir was completed in the year 1966. The fingerlings of major carps including catla were stocked for the first time in Kulgarhi reservoir in the year 1966 and again in the year 1968. The fry of silver carp (size range: 15-17 mm), which were obtained from Cuttack Sub-station of this Institute in September 1968, were reared in a nursery pond at Satna (M.P.) till the beginning of February 1969 and 229 fingerlings (size range: 121-216 mm) recovered from this nursery pond were stocked in the reservoir on 11.2.1969.

For comparing the growth patterns of catla and silver carp, 137 specimens of the former belonging to 1966 brood and captured from the reservoir from February 1968 to June 1972 and 12 specimens of the latter belonging to 1968 brood and captured from December 1969 to December 1972 have been utilized. The age of the individual specimen of catla and silver carp in terms of months has been determined on the basis of date of their recovery from the reservoir, assuming period of their hatching as August 1966 and August 1968 respectively.

For food studies, the guts of 11 specimens of silver carp and 11 specimens of catla obtained in the months of December 1969, September 1970, February 1971, June 1971, July 1971, March 1972 and June 1972 were examined and their gut-contents compared.

OBSERVATIONS

Food and feeding habits:

The observations on the gut-contents of silver carp and catla by Alikunhi and Sukumaran (1964) have shown that both are plankton feeders and the differences in feeding habits are only structurally indicated. Singh (1972) has stated that silver carp competes for food with catla, both being surface feeders. According to Chakraborty (1972), silver carp and catla are both dwellers of the same strata of water in ponds and there is some overlapping in the food spectrum of these two species. Laxshmanan *et al.* (1971) have observed keen competition for the same type of food between catla and silver carp.

Like catla, silver carp has a terminal mouth indicating surface feeding habits. The presence of insignificant quantities of decayed organic matter and sand mixed with mud in the guts of the two species in most of the months[4] in Kulgarhi reservoir has also indicated that the two species rarely feed at bottom.

The gut length in young silver carp (size range; 52-367 mm) is 3.0 to 7.8 times the total length of the fish (Inaba and Nomura 1956). In the present study, the ratio of fish length to gut-length in adult silver carp (size range: 575-795 mm) has been found to vary from 1:4.36 to 1:8.6 (Av.-1:6.25) and is almost comparable to that of catla (Range—1:5.5 to 1:9.58; Av.-1:7.39). This seems to indicate that the food and feeding habits of the two species are almost the same, as the length of the gut depends on the nature of the food taken by the fish (Mookerjee and Das 1945).

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[4] Only in the month of June when the water level in the reservoir was low, the guts of the two species were found to contain sufficient quantities of sand mixed with mud and the bottom debris.

The foregoing observations seem to give clue to the fact that when silver carp and catla are cultured together, they mutually compete for the same type of food. With a view to elucidate this point, the guts of the two species obtained during the corresponding months were examined for their contents. The overall composition of the gut-contents of silver carp and catla, as determined in the present study, has been compared and given in Table 1.

TABLE 1

COMPARISON OF GUT-CONTENTS OF SILVER CARP AND CATLA FROM KULGARHI RESERVOIR

Items of gut-contents	Silver carp	Catla
Sand mixed with mud	13.29%	5.75%
Decayed organic matter	7.14	7.19
Digested matter	40.29	67.95
Blue-green algae	4.32	12.96
Green algae	9.09	0.43
Diatoms	3.76	1.79
Dinoflagellates	1.07	0.06
Rotifers	20.81	2.31
Copepods	0.23	1.30
Cladocerans	—	0.26

According to Inaba and Nomura (1956), silver carp has specialised structure of the gill rakers adapted to micro-plankton feeding and is predominantly phytoplankton feeder. Alikunhi and Sukumaran (1964) have observed that silver carp feeds predominantly on phytoplankton and it is an efficient converter of basic food, whereas catla is predominantly zooplankton feeder.

In the present case (vide Table 1), silver carp and catla have been found to subsist on almost equal quantities of phytoplankton (18.24% and 15.24% respectively). Among phytoplankton, the green algae was the most dominant (9.09%) in the diet of silver carp, followed by blue-green algae (4.32%), diatoms (3.76%) and dinoflagellates (1.07%), whereas catla was found to feed predominantly on blue-green algae (12.96%) and insignificantly on diatoms (1.79%), green algae (0.43%) and dinoflagellates (0.06%). *Melosira, Eunotia, Cyclotella* and *Navicula* among diatoms; *Chlorella, Gloeocystis, Scenedesmus, Coelastrum* and *Tetraedron* among green-algae; *Microcystis* and *Merismopedia* among blue-green algae; *Peridinium* and *Ceratium* among dinoflagellates were the most dominant in the diet of silver carp. *Melosira* and *Cyclotella* among diatoms: *Gloeocystis* and *Scenedesmus* among green algae: *Microcystis* among blue-green algae; and *Peridinium* and *Ceratium* among dinoflagellates were likewise the most dominant in the diet of catla. In the guts of silver carp, the zooplankton (21.04%) was made up almost entirely of rotifers (20.81%), the only other component insignificantly represented being copepods (0.23%). Catla is known to be mainly zooplankton feeder. As the foregut in catla has a rudimentary stomach in the form of slightly dilated bulb, most of the crustaceans (copepods and cladocerans) get digested. As such the bulk of this group is encountered in digested condition (67.95%) and very little of it is in identifiable condition (copepods: 1.3% and cladocerans: 0.26%). In the diet of silver carp, *Keratella* among rotifers and *Cyclops* among copepods were the most common forms, whereas in the diet of catla, *Keratella* among rotifers; *Cyclops,* Nauplius and *Diaptomus* among copepods; and *Bosmina* and *Daphnia* among cladocerans were the most common forms.

The observations on the feeding intensity of silver carp and catla have indicated that the former is more voracious feeder than the latter. 50% of the guts of silver carp were full, the gastrosomatic index being 20.05. In comparison to silver carp, catla appears to be a moderate feeder (9.1% of the guts full and the gastrosomatic index—7.4). As catla feeds on crustaceans (nutritiously rich food), it

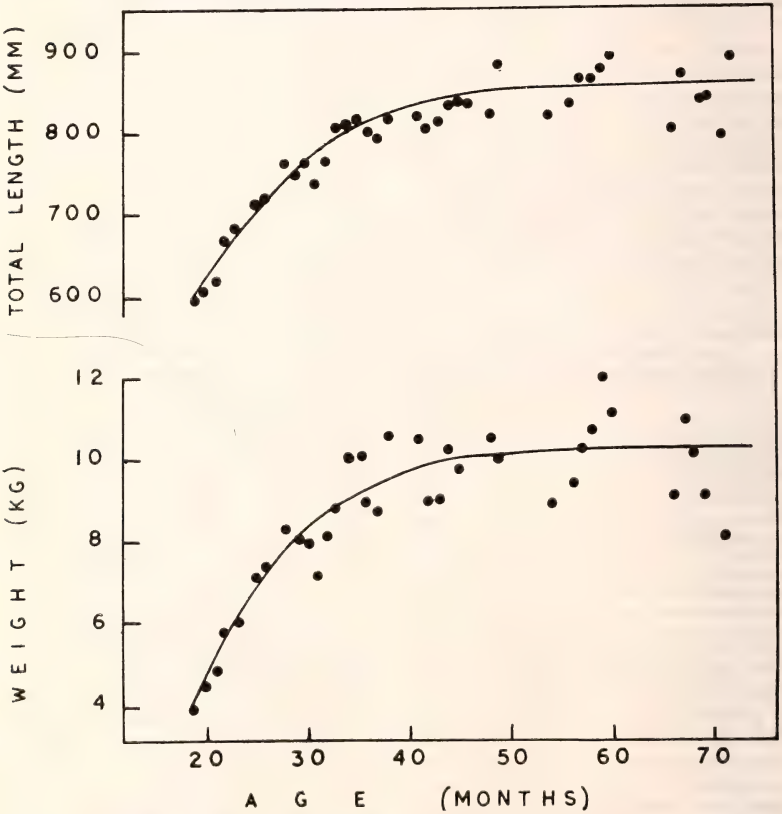

Fig. 1. Growth pattern, by length and weight, of catla (1966 brood).

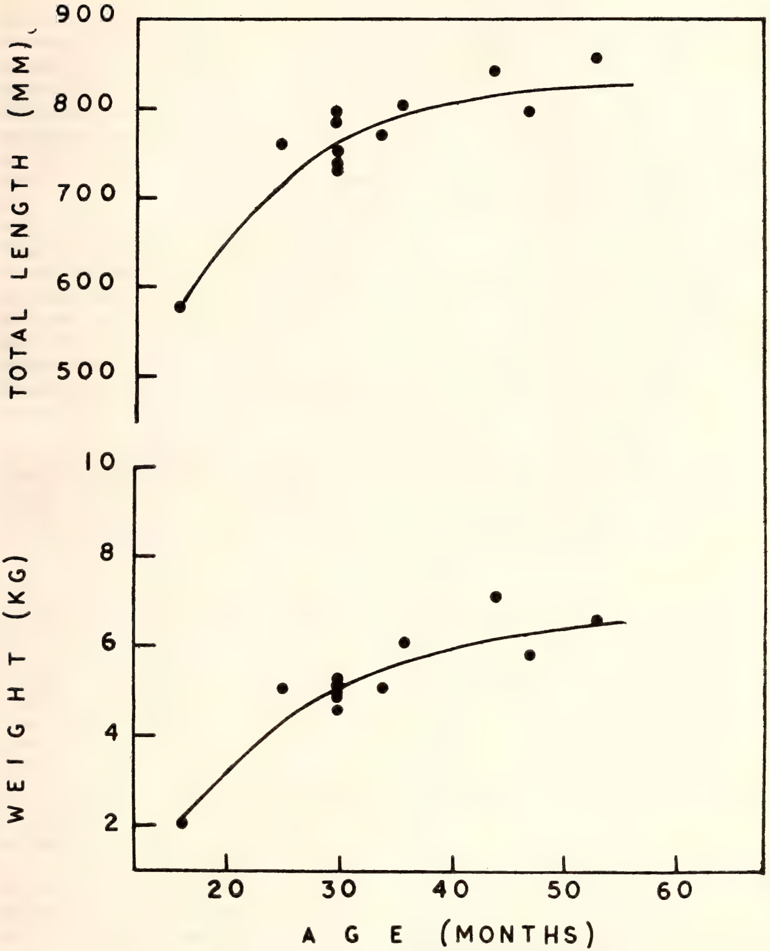

Fig. 2. Growth pattern, by length and weight, of silver carp (1968 brood).

requires comparatively little quantity of food for its normal fast growth. On the other hand, silver carp feeds abundantly on rotifers and sparingly on copepods. The two species subsist on almost equal quantities of phytoplankton. The food of silver carp is therefore not so nutritiously rich as that of catla. Hence, it is imperative that in order to attain fast growth, silver carp consume food at faster rates than catla.

Growth:

As already stated, the fingerlings of catla were stocked in the reservoir for the first time in the year 1966 and again in the year 1968. From the fact that the reservoir was not stocked with catla in the year 1967, it has been possible to separate catla specimens belonging to 1966 and 1968 broods captured from February 1968 to June 1972 and assign age to the individual fish in terms of months on the basis of date of their capture. As the fingerlings of silver carp were stocked in the reservoir only once in February 1969, the age in terms of months of 12 silver carp captured from the reservoir has also been determined from the date of their recovery (vide Appendix I). Based on the data on growth by length and weight of catla and silver carp, the growth curves for the two species have been drawn in figs. 1 and 2, and the growth in terms of months, as has been read off from the curves, is presented in Table 2.

From the analysis of growth data on silver carp and catla, the following facts emerged:

(i) The growth of silver carp was fast in the early period, i.e. upto 25 months (fig. 2), when the plankton was abundant and silver carp could feed voraciously on rotifers. But the growth of silver carp showed decline in the later period, i.e. in following 25 to 50 months, when rotifers were poorly represented in plankton (vide Table 3).

(ii) Catla belonging to 1966 brood showed normal growth up to the time silver carp was absent in the reservoir, but with the introduction of silver carp in February 1969, catla

TABLE 2

GROWTH OF SILVER CARP AND CATLA IN KULGARHI RESERVOIR

Date	Age (in months)	Total length (mm)	Growth rate (mm)	Weight (kg)	Growth rate (kg)
		SILVER CARP			
March '70	20	650	—	3.00	—
January '71	30	760	110	5.25	2.25
November '71	40	800	40	6.00	0.75
September '72	50	830	30	6.50	0.50
		CATLA			
March '68	20	610	—	4.50	—
*January '69	30	760	150	8.25	3.75
November '69	40	825	65	9.75	1.50
September '70	50	850	25	10.00	0.25
July '71	60	855	5	10.25	0.25
May '72	70	855	0	10.25	0.00

* Silver carp was introduced in the reservoir in February 1969.

showed retarded growth thereafter (fig. 1). Catla belonging to 1968 brood showed extremely poor growth from the very beginning.

From the above observations, it is evident that the culture of silver carp in Kulgarhi reservoir has adversely affected the growth of catla.

REMARKS

It is evident from the data presented that the growth of catla has greatly suffered since the time silver carp was introduced in Kulgarhi reservoir. Alikunhi and Sukumaran (1964) and Sukumaran *et al.* (1969) have stated that catla adversely suffers in competition for food in presence of silver carp. According to Singh (1972), silver carp competes for food with catla, both being surface feeders and the former grows much faster than the latter. Laxshmanan *et al.* (1971) have observed that the Indian carps and the Chinese carps compete to some extent for the same type of food and this competition is more pronounced between catla and silver carp. Chakraborty (1972) has also observed that catla and silver carp are both dwellers of the same strata of water in ponds and though the former feeds prodominantly on zooplankton and the latter predominantly on phytoplankton, there appears to be some overlapping in the food spectrum of these two species. The observations on the feeding habits of silver carp in Kulgarhi reservoir have, however, indicated that it is a more voracious feeder than catla and it feeds predominantly on rotifers. These observations are amply confirmed when the data on the yearly fluctuations in plankton population of Kulgarhi reservoir from 1968-69 to 1971-72, presented in Table 3, is critically examined. As is seen from this table, the population of rotifers and in turn that of zooplankton has suffered sharp decline immediately after the introduction of silver carp in the reservoir and the lower level of rotifers and con-

TABLE 3

YEARLY FLUCTUATIONS IN PLANKTON COUNT (UNITS PER LITRE) IN THE SURFACE COLLECTION SAMPLES OF KULGARHI RESERVOIR FROM 1968-69 TO 1971-72.

Plankton	1968-69	1969-70	1970-71	1971-72
Diatoms	53.0	106.2	32.6	6.0
Green algae	1.5	8.1	18.8	11.5
Blue-green algae	14.8	17.7	31.1	19.3
Dinoflagellates	123.3	184.2	150.9	5.0
PHYTOPLANKTON	192.6	316.2	233.4	41.8
Protozoans	13.7	15.9	36.6	0.9
Rotifers	155.6	45.4	63.6	7.1
Copepods	34.7	28.0	15.0	8.6
Cladocerans	6.7	1.9	6.6	2.6
ZOOPLANKTON	210.7	91.2	121.8	19.2
TOTAL PLANKTON	403.3	407.4	355.2	61.0

sequently that of zooplankton concentrations has continued to prevail during subsequent years (1969-70 to 1971-72). This phenomenon cannot be considered merely a coincidence, as rotifers in large quantities have been encountered in the guts of silver carp. Moreover, the depletion in rotifer population in Kulgarhi reservoir, which has been recently constructed, cannot be attributed to trophic depression (referred to by Jhingran 1965), as in that case the entire plankton population would have suffered depletion, which does not happen to be the case here. The total plankton, on the contrary continued to maintain almost the same level (355.2 to 407.4 u/l) during the first three years (1968-69 to 1970-71).

Since catla does not feed exclusively or even abundantly on rotifers, silver carp by feeding on rotifers does not seem to compete directly with catla in food. The overwhelming preference for rotifers (mostly *Keratella*) by silver carp has probably created imbalance in plankton production cycle, greatly affecting the production of zooplankton, which constitutes the main food of catla. Thus, it is probable that catla indirectly suffers in the presence of silver carp. Furthermore, silver carp is known to grow faster than catla (Alikunhi and Sukumaran 1964, and Singh 1972). It is therefore imperative that in order to maintain faster growth, silver carp devours plankton at faster rate. Singh (1972) also stated that silver carp has the capacity to utilize the natural food (phyto-and zoo-plankton) efficiently. As such, it is not difficult to visualize that in any body of water populated with silver carp, if the rate of plankton production does not keep pace with that of plankton consumption by silver carp, such waters would soon result in poor productivity and affect the normal growth of major carps, particularly catla, cultured along with it. It may therefore be surmised that it would not be a profitable proposition to culture silver carp along with catla in the reservoir. In view of these considerations, it is deemed proper to undertake further detailed biological studies on silver carp before its introduction in Indian reservoirs for large scale cultivation. In this context, Alikunhi and Sukumaran (1964) have expressed the view that 'further detailed observations are necessary before decision is taken about large-scale introduction of silver carp for cultivation in ponds in India'. Singh (1972) has also expressed the opinion that 'the question of release of silver carp in open waters where it could exercise some adverse effect on major carps fishery, particularly of catla, may await further investigations', as 'hasty transplantations for hobby or trade are likely to prove hazardous'.

Silver carp is reported to have more or less similar breeding habits as those of Indian major carps (Chaudhuri 1969) and it has been found to breed naturally in Tone river of Japan (Konradt 1968) and in Ah Kung Tian reservoir of Taiwan (Tang 1963). Instances of breeding of major carps in Indian reservoirs under suitable conditions are not rare. If silver carp is stocked in Indian reservoirs on large scale and it starts breeding in them naturally, it may prove to be a menace to the culture fishery of these waters.

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REFERENCES

ALIKUNHI, K. H. AND SUKUMARAN, K. K. (1964): Preliminary observations on Chinese carps in India. *Proc. Indian Acad. Sci.* (B) *60* (3): 171-188.

CHAKRABORTY, R. D. (1972): Composite culture of Indian and exotic fishes. *Silver Jubilee Souvenir,* Central Inland Fisheries Research Institute, Barrackpore, December 1972, *25*: 29.

CHAUDHURI, H. (1969): Breeding habits of cultivated fishes. *FAO/UNDP Regional Seminar on induced breeding of cultivated fishes, Calcutta, Cuttack, Bombay*: 1-13.

*INABA, D. AND NOMURA, M. (1956): On the digestive system and feeding habits of young Chinese carps collected from Tone river. *J. Tokyo Univ. Fish, 42* (1): 17-24.

JHINGRAN, V. G. (1965): Report on Inland Fisheries Research and management and fish culture in the USSR., *Misc. Contri. No. 5,* Central Inland Fisheries Research Institute, Barrackpore 1-27.

*KONRADT, A. G. (1968): Methods of breeding the grass carp, *Ctenopharyngodon idella* and silver carp, *Hypophthalmichthys molitrix. FAO Fish Rep.,* (44), *4*: 195-204.

LAXSHMANAN, M. A. V., SUKUMARAN, K. K., MURTY, D. S., CHAKRABORTY, D. P. AND PHILIPOSE, M. T. (1971): Preliminary observations on intensive fish farming in fresh-water ponds by the composite culture of Indian and exotic species., *J. Inland Fish. Soc., India, 3*: 1-21.

MOOKERJEE, H. K. AND DAS, B. K. (1945): Gut of carnivorous and herbivorous fishes in relation to their food at different stages of their life. *Proc. 32nd Indian Science Congress,* Part *III,* Abstracts.: 109.

RAO, J. B. AND DWIVEDI, R. K. (1972): On the recovery and growth of silver carp (*Hypophthalmichthys molitrix*) from Kulgarhi reservoir (M.P.). *J. Inland. Fish. Soc. India., 4*: 214-215.

SINGH, S. B. (1972): Role of exotic fish on pisciculture in India. *Silver Jubilee, Souvenir,* Central Inland Fisheries Research Institute, Barrackpore, 30-33.

SUKUMARAN, K. K., SINGH, S. B., MURTY, D. S. AND CHAKRABORTY, P. C. (1969): Studies on compatibility and competition between Silver carp, *Hypophthalmichthys molitrix* (Val.) and Catla, *Catla catla* (Ham.). *Proc. Indo-Pacif. Fish Coun., 13* (2): 185-194.

*TANG, Y. A. (1963): Report on the investigation of spawning of Chinese carps in Ah Kung Tian reservoir. *Bull. Taiwan Fish. Res. Inst.,* (8): 30 p.

* Not referred in original.

APPENDIX I

DETAILS OF RECOVERY OF SILVER CARP FROM KULGARHI RESERVOIR DURING THE PERIOD 3.12.1969 TO 22.12.72.

Sl. No.	Date of recovery	*Age (in months)	Total length (mm)	Weight (kg)	Sex
1	3.12.69	16	575	2.00	M
2	5.9.70	25	755	5.00	F
3	5.2.71	30	728	5.00	M
4	15.2.71	30	727	4.50	M
5	15.2.71	30	795	5.00	M
6	15.2.71	30	744	5.00	M
7	17.2.71	30	777	5.00	M
8	4.4.71	34	768	5.00	M
9	23.7.71	36	800	6.00	F
10	28.3.72	44	835	7.00	F
11	28.6.72	47	790	5.75	M
12	22.12.72	53	850	6.50	M

* Counted from August 1968.

NOTES ON THE FERNS AND FERN-ALLIES IN THE BOTANY OF ORISSA[1]

N. C. Nair[2] and R. K. Ghosh[3]

Psilotum nudum (Linn.) Griseb., *Helminthostachys zeylanica* (Linn.) Maxon, *Actiniopteris radiata* (Sw.) Link, *Pteris biaurita* Linn., *Pteris quadriaurita* (*sensu lato*), *Doryopteris concolor* (Langsd. *et* Fisch.) Kuhn, *Diplazium lasiopteris* Kunze, *Sphenomeris chinensis* (Linn.) Maxon, *Asplenium inaequilaterale* Willd., *Asplenium unilaterale* Lamk. var. *majus* (C. Chr.) Sledge, *Asplenium varians* Hook. *ex* Grev., *Colysis hemionitidea* (Wall.) Presl, *Pyrrosia mollis* (Kze.) Ching and *Pyrrosia nayariana* Ching *et* Chandra are reported from Orissa with notes of interest.

INTRODUCTION

In an earlier paper (Nair and Ghosh 1975) notes on eleven new distributional records to the Botany of Orissa have been given. Further critical study of our collections as well as those of earlier collectors from Orissa particularly from Koraput and Kalahandi Districts have enabled us to discover more interesting taxa of ferns and fern-allies several of which are found to be additions to the flora of Orissa. Notes on these taxa are presented here along with certain noteworthy features of other ferns collected from the area. With the present account the total number of ferns recorded so far from Orissa goes up to 116 (cf. Haines 1924, Mooney 1950, Panigrahi *et al.* 1964, Nair and Ghosh 1975, 1978).

The specimens mentioned are deposited in the herbarium of the Botanical Survey of India, Howrah (CAL). The arrangement of homosporous ferns are after Nayar (1974).

I. PSILOTACEAE

Psilotum nudum (Linn.) Griseb. in Abh. Ges. Wiss. Gotting. 7: 278, 1857; Clarke in Trans. Linn. Soc. London 2, Bot. 1: 589, 1880; Engl. Pflanzenw. Afr. 2: 76, fig. 75, 1908. *Lycopodium nudum* Linn. Sp. Pl. 2: 1100, 1753. *Psilotum triquetrum* Sw. Syn. Fil. 187, 1806; Baker, Fern Allies 30, 1887; Adams et Alston in Bull. Brit. Mus. 1: 185, 1955.

This is predominantly a tropical and subtropical taxon and is common along the coastland of India particularly among the adventitious roots of coconut trees. Sometimes it grows on mossy moist rocks in shade. The present specimens were collected from steep mossy rocks along the banks of Karandy river. The species has an altitudinal range from sea level up to 1250 m.

Material examined. Dodari, Koraput Dist., 1200 m, *N. C. Nair* 53258 (6-2-1976), 53297 (9-2-1976).

II. OPHIOGLOSSACEAE

Helminthostachys zeylanica (Linn.) Hook. Gen. t. 47, 1840; Bedd. Handb. Ferns. Brit. India 467, 1883; C. Chr. Ind. Fil.

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344, 1906; Haines, Bot. Bihar, Orissa, 3: 1268, 1924. *Osmunda zeylanica* Linn. Sp. Pl. 1063, 1753.

Haines (1924) states that he could not find any specimen from Bihar or Orissa. But, he did see specimens from Bengal. This appears to be a rare taxon in Orissa. Although we made extensive exploration in Koraput and Kalahandi districts we could not come across this species. The present record is based on the collections of Shri D. C. S. Raju. We are thankful to him for placing his collection at our disposal.

Material examined: Dharmagod Reserve forest near Govindapally (Koraput Dist.), *D. C. S. Raju* 1242 (19-11-1963), 2403 (10-8-65). On southern slopes in sal forest.

III. PTERIDACEAE

1. **Actiniopteris radiata** (Sw.) Link, Fil. Sp. Hort. Reg. Bot. Berol. Cult. 80, 1841; Bedd. Ferns. South India t. 124, 1865; Pichisermolli in Webbia, 17: 318, 1963. *Asplenium radiatum* Sw. in Schrad. Journ. Bot. 1800: 50, 1801. *Actiniopteris dichotoma* Forsk. Fl. Aeg.-Arb. 184, 1775 (*non* Linn. 1753)); Bedd. Handb. Ferns. Brit. India 197, t. 98, 1883. *Actiniopteris australis* auct. (*non* Link, 1841).

Mooney (1950) states that "it seems very doubtful if this fern occurs within the boundaries of our province". We have seen several collections from the area. This appears to be a rare species in Orissa.

Material examined: Sunki, *D. C. S. Raju* 2090 (24-7-1965), *D. C. S. Raju* 9655; Koraput Dist. *D. C. S. Raju* s.n.

2. **Pteris biaurita** Linn. Sp. Pl. 1076, 1753; Haines, Bot. Bihar, Orissa 1203, 1924. Mooney, Suppl. Bot. Bihar, Orissa 222, 1950. *Campteria biaurita* (Linn.) Hook. Gen. Fil. t. 65A, 1841; Bedd. Handb. Ferns. Brit. India 116, 1883.

This pantropic species has been collected from several localities in Orissa. It has a liking for lightly shady moist places particularly near streams and springs. This has 5 to 9 pairs of opposite pinnae with an apical pinna having the same shape like all the others. The lowest pair of pinnae are the longest of the lot and are again branched near the base. This being the usual condition we have come across a large plant of (over 2 m) the taxon near a stream on Devi hill, Jeypore (Koraput Dist.), in which each of the lowest pair of pinnae had four secondary pinnae each, on the basiscopic side. Each of the branches had 20-26 falcate and widely spaced segments.

Material examined. Devi Hill, Jeypore (Koraput Dist.), *N. C. Nair* 51312 (25-10-73).

3. **Pteris quadriaurita** Retz. in Obs. Bot. 6: 38, 1791 (?)

It has been shown earlier (Nair and S. R. Ghosh 1975) that *Pteris quadriaurita* Retz. is strictly a Ceylonese and South Indian species and that the reports of the taxon from other parts of the subcontinent of India need confirmation. Typical *Pteris quadriaurita* Retz. has segments with rounded and serrated apex, sinus reaching nearly to the costa and the lower branch of the lowest vein reaching above sinus (Hieronymus 1914). In the present study we have come across a plant with venation similar to that of *P. quadriaurita* Retz., but the apex of the segments was not serrated. The costa and costules of this plant were sparsely white hairy on the lower surface. There are very few hairs on the upper surface of the segments as well as on the costa. On the lower surface of some of the pinnules there were adventitious buds on the costa developing into plantlets. Generally leaves sprouting from bulbils have the same form as leaves of the parent plant. But here, fronds arising from the adventitious buds are very different from the ordinary parent frond. Similar heteromorphy in leaves of the genus has been earlier reported by Masters (1868).

On an examination of specimens belonging to *Pteris* from the Central National Herbarium, Sibpur, we have come across a specimen collected from Manipur, Naga Hills, by *S. K. Mukerjee* 3477 and determined by G. Panigrahi as *Pteris biaurita* Linn. showing adventitious buds on the lower side of the frond. It is certainly not *Pteris biaurita* since the lowest veins of segments are not arching. This specimen also has segments with non-serrated apex and the basal branch of the lowest vein of the segment reaches above the sinus. But the specimens differ from our plant in having (1) purplish costa and costule and (2) glabrous costa and costule.

While it is certain that the Orissa specimens do not belong to *Pteris quadriaurita* Retz. (*sensu stricto*) their taxonomic status will remain open to question till further materials are at hand.

Material examined. Devmali (Koraput Dist.), 1500 m, *N. C. Nair* 53289 (7-2-1976) under deep shade near stream.

IV CHEILANTHACEAE

1. **Doryopteris concolor** (Langsd. et Fisch.) Kuhn, V. Decken Reis. 3, Bot. 19, 1789; C. Christens. Ind. Fil. 243. 1906; Nayar *et* Kaur Companion Bedd. Handb. Ferns Brit. India 28, 1974. *Pteris concolor* Langsd. *et* Fisch. Ic. Fil. 19, t. 21, 1810. *Pteris geraniifolia* Bedd. Ferns. South India t. 37, 1863. *Pellaea geraniifolia* Hook. *et* Bak. Syn. Fil. 146. 1865. *Pellaea concolor* (Langsd. *et* Fisch.) Bedd. Handb. Fern. Brit. India 100, 1883.

In India this fern has been previously reported only from the Western Ghats of the former Presidency of Madras, at an altitude above 1000 m. In these places it is reported to be a common species.

We have collected the species from areas adjoining Orissa, such as Anantagiri and Sankermata in Andhra Pradesh from altitudes between 1000-1500 m, *N. C. Nair* 53518. From this it can be safely concluded that it is a species common to both Eastern Ghats and Western Ghats at higher elevations.

Material examined. Dodari (Karandi river bank), Koraput Dist. 1110 m, *N. C. Nair* 53294 (Feb. 9, 1976) in crevices of rocks, common.

V DENNSTAEDTIACEAE

Microlepia platyphylla (D. Don) J. Sm., in Jour. Bot. 1: 427, 1842; Bedd. Ferns. South. India t. 13, 1863 *et* Handb. Ferns. India 66, t. 33, 1883; Nayar *et* Kaur in Bull. Nat. Bot. Gard. 79: 12, 1963 *et* Compan. Bedd. Handb. Ferns Brit. India 19, 1974. *Devallia platyphylla* D. Don, Prodr. Fl. Nepal. 10, 1825.

This is a large elegant fern over 2 m tall. The lamina when young is hairy on costa and costule, and when mature, glabrous on both surfaces or sometimes hairy on the vein above in fertile lobes. This is a widely distributed taxon in India but has not so far been collected from Orissa.

Material examined. Devmali (Koraput Dist.), 1500 m, *N. C. Nair* 53280 (7-2-1976) under deep shade near stream; common in this area only.

VI DRYOPTERIDACEAE

1. **Diplazium lasiopteris** Kunze in Linnaea 17:

568, 1843; Bedd. Ferns. South India, 53, t. 160, 1863; Sledge in Bull. Brit. Mus. (Nat. Hist.) 2: 296, t. 30, f. 10, 1962. *Asplenium thwaitesii* A. Braun *ex* Mett. in Abhandl. Senekenb. Naturforsch. Ges. 3: 227, 1859; Hook. *et* Bak. Synops. Fil. 235, 1867. *Diplazium thwaitesii* (A. Braun *ex* Mett.) Klotzsch *ex* T. Moore, Index Fil. 339, 1862; Bedd. Fern. Brit. Ind. t. 291, 1868. *Diplazium japonicum sensu* Bedd. Handb. Ferns. Brit. India 180, 1883 (*Pro parte*) *non* Bedd. (1876) *nec Asplenium japonicum* Thunb.

This is a common species in South India and Ceylon. The taxon appears to be very variable as to its robustness.

Beddome (1883) united this species with *Diplazium japonicum sensu lato*. According to Sledge (1962) *Diplazium japonicum sensu stricto* and *Diplazium lasiopteris* Kunze are distinct. Beddome's *Diplazium japonicum* also includes *Diplazium polyrhizon* (Baker) Sledge which is endemic to Ceylon.

In the distribution of *Diplazium japonicum* (*sensu* Beddome), Beddome (1883) gives Jeypore hills. Although we made extensive search for the species in the mountainous region in the neighbourhood of Jeypore we could not come across even a single specimen of *Diplazium lasiopteris* Kunze in the area. The present specimen was collected from Devmali (Dodari), the eastern most region of Koraput District, which is continuous with the mountain ranges of Visakhapatnam District. In the Indian subcontinent this species is usually found above an altitude of 1000 m in deep forests.

Material examined. Devmali (Dodari, Koraput Dist.), 1500 m, *N. C. Nair* 53274 (7-2-1976)—under deep shade in rocky place near spring.

2. **Sphenomeris chinensis** (Linn.) Maxon in Wash. Acad. Sci. Jour. 3: 114, 1913; Nair in Bull. Bot. Surv. India 11: 187, 1969; *Trichomanes chinensis* Linn. Sp. Pl. 2: 1099, 1753. *Adiantum chusanum* (Linn.) Bedd. Handb. Ferns Brit. *chinensis* (Linn.) Mett. *ex* Kuhn Fil. Afr. 67, 1868. *Stenoloma chinensis* (Linn.) Bedd. Handb. Ferns. Brit. India 70, t. 34, 1883 (excl. Syn. *Davallia tenuifolia* Alston *et* Bonner in Candollea 15: 198, 1956). *Odontosoria chinensis* (Linn.) J. Sm. Bot. Voy. Herald 430, 1897; Haines Bot. Bihar Orissa 3: 1248, 1924; Mooney Suppl. Bot. Bihar, Orissa 219, 1950. *Sphenomeis chusana* (Linn.) Copel. *in* Bish. Mus. Publ. 59: 69, 1929; Holttum, Fl. Malaya 2: 341, 1954; Tagawa, Col. Ill. Jap. Pterid. 257, 1959.

Haines (1924) and Mooney (1950) reported it only from the border areas of Madhya Pradesh and Bihar and Bihar and Bengal (Singhbhum). In Koraput and Kalahandi districts this is not a rare fern. Sometimes it reaches a length up to 80 cm. It is generally found on moist cuttings along hill-roads in shade.

Material examined. Along Karandi river, Dodari (Koraput Dist.), 1550 m, *N. C. Nair* 53252 (Feb. 6, 1976) — along with *Nephrolepis*. Very common in this area.

VII. ASPLENIACEAE

1. **Asplenium inaequilaterale** Willd. in Linn. Sp. Pl. ed. 4, 5: 322, 1810; Hieron *in* Hedwigia 61: 22, 1919; Sledge *in* Bull. Brit. Mus. (Nat. Hist.) 3: 252, 1965, *Asplenium trapeziforme* sensu Bedd. Ferns. South India 45, t. 134, 1864 (*non* Roxb.). *Asplenium lunulatum* var. *trapeziforme* Bedd. Handb. Ferns. Brit. India 148, 1883 *pro parte* (*non A. trapeziforme* Roxb.)

This is a typical tropical fern of South America, Africa, Madagascar, Sri Lanka, etc. In India this species has been previously reported only from Palnis, Nilgiris, Anamalays, and Bombay. The present discovery extends its distribution further east. Our plants were between 30-40 cm tall and very membraneous. It loves deep shade and grows amidst boulders near streams.

This fern has been confused in the past with *Asplenium unilaterale*. Christensen (1906) treated *Asplenium inaequilaterale* and *Asplenium unilaterale* as conspecific. Beddome (1883) considered *Asplenium trapeziforme* Roxb., from Malaya, also as conspecific. But, Roxburgh's species is very distinct from *Asplenium inaequilaterale* in the veins running to the extremities of the marginal teeth (cf. Sledge 1965) and in the shape of the pinnae.

This species grows side by side with *Asplenium unilaterale* Lamk. to which it has superficial similarity.

Material examined. Saput, Padwa, (Koraput Dist.) *N. C. Nair* 53215 (28-1-1976).

2. **Asplenium unilaterale** Lamk. var. **majus** (C. Chr.) Sledge in Bull. Brit. Mus. (Nat. Hist.) 3: 246, 1965. *Asplenium unilaterale* forma *majus*. C. Chr. in Bernice P. Bishop Mus. Bull. 177: 67, 1943.

According to Sledge (loc. cit.) this taxon is found in northern and southern India. But so far no one has collected it from Orissa. This appears to be a variable species as far as the size of the plant is concerned.

It is a shade-loving fern often growing on wet mossy rocks by streams.

Material examined. Devmali, Koraput Dist. (1500 m) *N. C. Nair* 53275, 53287 (7-2-1976) common; Rastaguda forest, Kasipore, Koraput Dist. (900 m) *N. C. Nair* 51418 (8-11-1973).

3. **Asplenium varians** Hook. & Grev. Ic. Fil. 2: t. 172, 1829; Hook. Sp. Fil. 3, 192, 1810; Bedd. Ferns South. India 44, t. 129, 1864; Handb. Ferns Brit. India 158. 1883; Hope in J. Bombay nat. Hist. Soc. 13: 667, t. 20, 1901; Sledge *in* Bull. Brit. Mus. (Nat. Hist.) 3: 272, 1965.

This is a small shade-loving fern with herbaceous and delicate fronds. It is very rare in Orissa and has been collected only from one locality.

Material examined. Rastaguda forest, Kasipore (Koraput Dist.) 900 m, *N. C. Nair* 51427 (Nov. 8, 1973).

VIII POLYPODIACEAE

1. **Colysis hemionitidea** (Wall.) Presl, Epim. 147, 1849; Nayar *et* Kaur Companion Handb. Bedd. Ferns. Brit. India 87, 1974. *Polypodium hemionitideum* Wall (Cat. 284, 1828 *nomen nudum*) *ex* Mett. Farngatt. 1 : 215, 1857; Clarke *in* Trans. Linn. Soc. Ser. 2. 1: 561, 1880. *Pleopeltis hemionitidea* (Wall.) Bedd. Handb. Ferns. Brit. India 359, 1883.

This fern has been previously reported from the western mountains of southern India, Himalayas and Khasia hills. This has a single row of rounded or elongated (oblong) sori between adjacent main veins which separate the two rows of areoles. In Central National Herbarium (CAL) there are several sheets identified by C. B. Clarke and others as *Colysis hemionitidea* (*Polypodium hemionitideum, Pelopeltis hemionitidea*) which have two rows of sori between the main veins which separate the two rows of areoles. We have also seen several sheets of this kind from Sri Lanka. In general they have similarity with specimens of *Microsorum zippelii* (Bl.) Ching but to determine whether both are identical or not needs further intensive study. Holttum

(1954) remarked that *Colysis hemionitidea* and *Colysis acuminata* (Bak.) Holttum "should perhaps be united". Although both the species have general similarity we could not arrive at a definite decision with the limited material at our hand. If both turn out to be conspecific in future, *Colysis hemionitidea* (Wall.) Presl alone can be the correct name for the species.

In India this generally grows above an altitude of 400 m in deep shade near streams and springs. In Orissa it appears to be a rare species having been collected only from two places.

Material examined. Devmali, Near Dodari, Koraput Dist., 1500 m, *N. C. Nair* 53281 (Feb. 7, 1976); Dodari (on the bank of Karandi river), Koraput Dist., 1100 m, *N. C. Nair* 53267 (Feb. 2, 1976).

2. **Pyrrosia mollis** (Kze.) Ching in Bull. Chin. Bot. Soc. 1: 53, 1935; Nayar *et* Chandra. Bull. Nat. Bot. Gard. No. 117: 67, 1965; Nayar *et* Kaur, Companion Bedd. Handb. Ferns Brit. India 81, 1974; Bedd. Ferns. Brit. India 330, 1883 (pro parte).

Nayar *et* Chandr. (Loc. cit.) gives the distribution as Western Ghats and Nilgiri Hills, hills of Assam, and Central and Eastern Himalayas at altitude between 1000-3000 m elevation. In Orissa it has been collected only from one place. It was an epiphyte on mango trees.

Material examined. Kasipore (Koraput Dist.), 1100 m, *N. C. Nair* 50537 (Sept. 30, 1972).

3. **Pyrrosia nayariana** Ching et Chandra in Amer. Fern Journ. 54: 62, 1964 *et* Bull. Nat. Bot. Gard. 117: 70, 1965.

This was considered to be a very rare species confined to Manipur (NE. India). In Orissa this epiphyte has been collected only from one place.

Material examined. Kasipore (Koraput Dist.) 950 m, *N. C. Nair* 51396 (Nov. 6, 1973).

REFERENCES

BEDDOME, R. H. (1864): Ferns of Southern India, Madras.

——— (1883): Handbook to the ferns of British India, Ceylon and the Malay Peninsula, Thacker Spink & Co., Calcutta.

CHRISTENSEN, C. (1906): Index Filicum. Hafniae.

CLARKE, C. B. (1880): A review of the Ferns of the Northern India. *Trans. Linn. Soc. London. Series* (Bot.) *1*: 425-619.

HAINES, H. H. (1924): Botany of Bihar and Orissa. London.

HEIRONYMUS, G. (1914): *Pteris quadriaurita* Retz. und einige asiastische, malesische und polynesische Arten aus der Gruppe und Verwandschaft dieser Art.: 325-375.

HOLTTUM, R. E. (1954): A revised flora of Malaya II. Ferns of Malay. Singapore.

MASTERS, M. T. (1868): Vegetable Teretology. Ray Society, London.

MOONEY, H. F. (1950): Supplement to the Botany of Bihar and Orissa. Ranchi.

NAIR, N. C. & GHOSH, R. K. (1975): Additional distribution of Ferns to the Botany of Orissa. *J. Indian Bot. Soc. 54*: 45-49.

——— ——— (1978): *Pteris heteromorpha* Fee—A new record for India. *Indian For. 104*: 374-376.

——— & GHOSH, S. R. (1977): *Pteris quadriaurita* Retz. and its related taxa in Kerala. *J. Bombay nat. Hist. Soc. 73*: 438-443.

NAYAR, B. K. (1974): A classification of homosporous ferns. *In* B. K. Nayar and Surjit Kaur, Companion to R. H. Beddome's Handbook to the Ferns of British India, Ceylon and Malay Peninsula. 109-201, New Delhi.

PANIGRAHI, G. S., CHOWDHURY, D. C., RAJU, S. & DEKA, G. K. (1964): Contribution to the botany of Orissa. *Bull. bot. Surv. India. 6*: 237-266.

SLEDGE, W. A. (1962): The Athyrioid Ferns of Ceylon. *Bull. Brit. Mus. 2* (11): 275-325.

——— (1965): The Ceylon species of *Asplenium*. ibid. *6*: 235-277.

DISTRIBUTION RECORDS OF CULICINE MOSQUITOES OF BASTAR DISTRICT, MADHYA PRADESH, INDIA (DIPTERA: CULICIDAE)[1]

ZAKIR HUSAIN HUSAINY[2]

(*With a text-figure*)

INTRODUCTION

Prakash and Husainy (1974) listed *Anopheles* mosquitoes taken in 102 villages of Bastar district, Madhya Pradesh between October 1968 and September 1974. Outdoor collections were made at various sites between the larval habitats and the village homes in order to determine the outdoor resting habits of the anophelines. In these surveys culicines were of course encountered along with the anophelines. The present paper lists the Culicini (Culicidae) collected.

In all 24 villages were selected for outdoor surveys which had the village of Asirguda located at 48.5 m a.s.l., as the lowest, and the locality Kirandul situated at 1275.5 m a.s.l. as the highest altitudes of the district. The majority of the villages are located in the North Eastern plateau and its sub-division, the Indravati plains. The general elevation of these physiographic divisions ranges from 457 to 609 m a.s.l. The climate is in the hot-wet to hot-moist range.

The villages which are sparsely populated, consist of several hamlets each with a few hutments situated at some distance from each other. Each family of the village essentially keeps such domestic animals as cow, goat, pig, dog and poultry. Most of these are accommodated in cattle sheds.

The larval habitats in the area may be streams, ponds, ditches and seasonal pools. Large broken earthenwares are generally thrown in the backyard of the hutments in which sufficient rain water accumulates to provide larval breeding sites for aedine mosquitoes. In between the hutments and the larval habitats, grasses and shrubs are commonly found apart from the trees.

MATERIALS AND METHODS

Outdoor collections were made in natural vegetation, bushes, tree holes, crevices etc., located between the larval habitats and nearest human dwellings. An outdoor pit shelter (2 m × 1 m × 2 m) was constructed in one village (Bispur) in this connection. The collections were generally attempted in the morning between 0600 and 0900 hr. A few man-biting rate observations were also taken to detect the species preferring human blood meals. This was done by placing a man as bait in human dwellings and collecting only the mosquitoes actually feeding on this bait since landing rates do not always indicate biting.

RESULTS OF OBSERVATIONS

A total of 1,014 specimens representing 14

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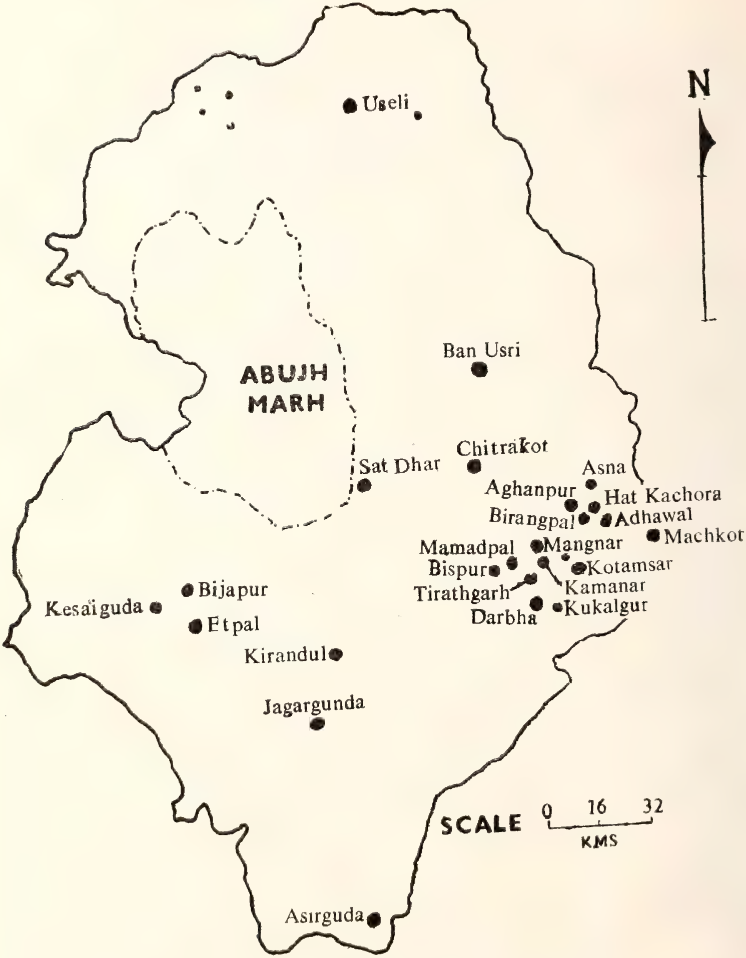
N
Useli
ABUJH MARH
Ban Usri
Chitrakot
Sat Dhar
Asna
Aghanpur
Hat Kachora
Birangpal
Adhawal
Machkot
Mamadpal
Mangnar
Bispur
Kotamsar
Tirathgarh
Kamanar
Darbha
Kukalgur
Kesaïguda
Bijapur
Etpal
Kirandul
Jagargunda
SCALE
0
16
32
KMS
Asirguda

Fig. 1. Map of Bastar District showing the villages surveyed.

culicine species were collected in 24 localities of Bastar distirct. The locations of the villages surveyed are shown in the map (Fig. 1). More culicine mosquitoes (1,014 specimens) than anopheline (232 examples) were encountered in outdoor surveys. In the man-biting rate observations a total of 263 culicine and 67 anopheline females were captured in 80 man-hours. Thus more culicine than anopheline females had bitten human beings in the given time. Among culicines, the highest numbers were of *C. p. fatigans* (76 examples) and lowest were of *M. uniformis*.

The species wise habitat of all the recorded culicine mosquitoes is given below. The classification system enumerated by Stone *et al.* (1959) has been followed in this paper.

Genus: *Aedes* Meigen 1818

Aedes (Stegomyia) albopictus (Skuse), 1895

Specimens collected: Ban Usri 3 females (fm); Tirathgarh 1 fm; Mamadpal 9 fm; Jagargunda 3 males (m), 2 fm; Kirandul 7 fm; Sat Dhar 3 fm; Darbha 6 fm; Chitrakot 7 fm; Bijapur 15 fm; Kesaiguda 2 fm; Hat Kachora 1 m; Adhawal 1 fm; Useli 3 m, 4 fm; Kotamsar 29 fm; Kamanar 2 m, 8 fm; Kukalgur 5 m, 2 fm; Aghanpur 1 m, 9 fm; Asna 2 fm. Total 15 m and 110 fm.

Distribution: This species was recorded in the North-Eastern plateau, Godavari-Sabri lowlands, Bailadila hills, Indravati plains and Southern plateau of the Bastar district.

Altitudes: Encountered between 48.5 and 1275.5 m a.s.l.

Seasonal prevalence: Collected in January, May, July and November in the hot-moist, hot-wet, moderately hot-moist and vey hot-moist climatic regions of the district.

Observations: *A.* (*S.*) *albopictus* is a dominant species in the district. A massive attack on human being for feeding in the day was noticed in the forests of the village Kotamsar. In the township of Jagdalpur, this mosquito is predominantly a day-time feeder. Baisas (1974) stated that *A. albopictus* attacks man but in places far away from human dwellings, it probably feeds on animals. Specimens of *A. albopictus* were captured on human body while collecting and from bushes, tree holes and fences. Twenty females were taken inside houses. Joshi *et al.* (1965) collected five females outdoors in jungles of Nepal. The breeding in Bastar district was noticed in broken earthen pots retaining rain water. Baisas (1974) stated that *A. albopictus* breeds mostly in tree holes in Subic, seldom in bamboo, rock holes and artificial containers. Huang (1972) stated that the immature stages of *A. albopictus* have been found mainly in tree holes, bamboo stumps and artificial containers in Philippines, Ryukyu Island, Taiwan, Vietnam, Thailand, Malaysia, Burma and India. Peters and Dewar (1956) reared *A. albopictus* and *A. w-albus* from eggs contained in the dried residue in holes in mango trees. These eggs had survived at least seven months since the last rainy season and hatched within a day or two of addition of water.

Aedes (Mucidus) sactophagoides (Theobald), 1901

Specimens collected: Mangnar 7 m, 2 fm; Darbha 4 m, 6 fm; Adhawal 3 m, 2 fm; Ban Usri 3 fm; Jagargunda 2 fm; Sat Dhar 1 fm. Total 14 m, 16 fm.

Distribution: Recorded in the Indravati plains, North-Eastern plateau, Godavari-Sabri lowlands and Tinkanpalli hills.

Altitudes: 152 to 761 m a.s.l.

Seasonal prevalence: Collected in March, May, July, September and October in the hot-wet, hot-moist and very hot-moist climatic regions.

Observations: This mosquito was taken in bushes near a stream (Darbha); from fence crevices (Adhawal), underneath the logs (Kukalgur) and from a pit shelter (Bispur). Joshi *et al.* (1965) took three females each from a mosquito net and inside a house in Nepal.

Aedes (Stegomyia) w-albus (Theobald), 1905
Specimens collected: Mangnar 11 m, 3 fm; Darbha 4 m, 3 fm; Adhawal 2 m; Hat Kachora 2 fm; Ban Usri 3 fm, Useli 5 fm: Total 17 m, 16 fm.
Distribution: Recorded in the Indravati plains, North-Eastern plateau of Bastar district.
Altitudes: Between 457 and 761 m a.s.l.
Seasonal prevalence: Collected in March, May, July and September in the moderately hot-moist, hot-moist and the hot-wet climatic regions.

Observations: Specimens of *A. w-albus* were secured in a pit-shelter (Bispur); ponds (Ban Usri), tree holes (Useli) and from tall grass (Mangnar). Joshi *et al.* (1965) collected two females from a jungle in Nepal.

Aedes (Stegomyia) aegypti (Linnaeus), 1762

This species was not encountered anywhere in the district although diurnal surveys were made in the townships of Jagdalpur, Kirandul and Kanker. It requires further study to ascertain if this mosquito is prevalent in Bastar district, for this is typically a dense forest area. However, at present, forests are being cleared and the towns are growing in magnitude. Baisas (1974) reported the distribution of this mosquito in South-East Asia, Indo-Malayan region and elsewhere where modern transportation distributed this mosquito.

Aedes (Stegomyia) vittatus (Bigot), 1861
Specimens collected: Machkot 5 fm; Ban Usri 2 fm; Kotamsar 17 fm; Tirathgarh 1 fm; Darbha 3 fm; Mamadpal 2 fm; Mangnar 1 m; Chitrakot 6 fm; Kesaiguda 3 m, 3 fm; Useli 2 fm; Kukalgur 7 fm; Bispur 3 m, 2 fm; Aghanpur 2 m, 2 fm; Asna 2 m, 3 fm. Total 11 m, 55 fm.
Distribution: Recorded in Indravati plains, North-Eastern plateau and Southern plateau.
Altitudes: Encountered between 48.5 and 761 m a.s.l.
Seasonal prevalence: Recorded in May, from July to November in the hot-wet and the hot-moist climatic regions.
Observations: Predominant in forests of Bastar district. Specimens of *A. vittatus* were caught on human beings and from bushes in the forests. Five females were secured in tree holes (Machkot) in forests. Joshi *et al.* (1965) collected two examples of this mosquito from jungle in Nepal.

Genus: *Culex* Linnaeus 1758

Culex (Culex) bitaeniorhynchus Giles, 1901
Specimens collected: Kotamsar 2 fm; Mamadpal 1 fm; Kukalgur 6 fm; Kesaiguda 1 m, 1 fm; Bispur 3 m, 1 fm; Darbha 3 m, 4 fm, Kamanar 1 m, 4 fm: Total 8 m, 19 fm.
Distribution: Recorded in the Indravati plains; North-Eastern plateau, Southern plateau. Bram (1967) reported distribution in Thailand, Ethiopia including Madagascar, Australia, New Guinea, some islands of the South Pacific and the Soviet Far East.
Altitudes: 152 to 671 m a.s.l. Peters and Dewar (1956) collected larvae of *C. bitaeniorhynchus* from residual pools in the main river beds at Bhimphedi, Nepal at 11,583 m height.
Seasonal prevalence: Encountered in March, May, July, September and November in the hot-wet and hot-moist area.
Biting habits: Twenty one females were captured on human bait. In Singapore the origin of blood meals in females collected from unbiased sources were exclusively from birds (Colless 1959 as quoted by Bram 1967).
Observations: Recorded in forests of Bastar district. This mosquito was taken in bamboo fences in the courtyards (Darbha); from a pit shelter (Bispur), green grass in the vicinity of hutments (Tirathgarh). Joshi *et al.* (1965) collected this mosquito inside houses in Nepal.

Culex (Culex) epidesmus (Theobald), 1910.
Specimens collected: Ban Usri 1 m; Kukalgur 3 fm; Jagargunda 5 m, 2 fm; Sat Dhar 1 m, 2 fm, Darbha 5 m, 5 fm; Kamanar 3 m, 10 fm; Aghan-

pur 32 m, 35 fm; Adhawal 18 m, 27 fm; Asna 16 m, 13 fm; Hat Kachora 28 m, 22 fm; Useli 6 m, 11 fm; Kotamsar 3 fm; Kesaiguda 6 m, 2 fm; Bispur 4 m, 5 fm, Birangpal 2 m, 2 fm: Total 127 m, 142 fm.

Distribution: Recorded in the North-Eastern plateau; Godavari Sabri lowlands; Tinkanpalli hills, Indravati plains and Dantewara plains.

Altitudes: 48.5 to 761 m a.s.l.

Seasonal prevalence: Collected all round the year in the hot-moist, hot-wet, moderately hot-moist and very hot-moist climatic regions. Abundant during August in village Hat Kachora.

Biting habits: A total of 76 females were secured from human bait.

Observations: Predominant species all over the district. Collected from bushes near the fencing of a farm; from pit shelter, and from vegetation in the vicinity of houses. Joshi *et al.* (1965) took females from inside houses and one female from pit shelter in Nepal.

Culex (Culex) pipiens fatigans Wiedemann, 1828

Specimens collected: Machkot 35 fm; Ban Usri 2 fm; Kukalgur 1 m, 1 fm; Mamadpal 4 fm; Mangnar 9 m, 5 fm; Kamanar 1 m, 12 fm; Kirandul 3 m, 5 fm; Chitra Kot 5 m, 3 fm; Etpal 1 m; Bijapur 1 fm; Bispur 6 m, 6 fm; Birangpal 1 fm; Asirguda 8 fm; Useli 9 m, 4 fm; Hat Kachora 5 m, 7 fm; Adhawal 3 m, 3 fm; Aghanpur 6 m, 7 fm; Asna 2 m, 5 fm: Total 51 m, 109 fm.

Distribution: Recorded in the Indravati plains; North-Eastern plateau; Bailadila hills, Godavari-Sabri lowlands. This mosquito is distributed throughout the world in tropical and sub-tropical areas (Baisas 1974).

Altitudes: 48.5 to 1275.5 m a.s.l.

Seasonal prevalence: Collected all round the year in the hot-moist, hot-wet, moderately hot-moist and very hot-moist climatic regions.

Biting habits: From human bait 97 females were taken. Seven blood meals obtained from adult females taken out of doors had two smears positive for human and five for bovine blood. Baisas (1974) indicates that from its large number it constitutes the most annoying *Culex* to human beings. Very seldom taken in Carabao-baited traps but numerous in human baited traps and in unscreened houses, barns and huts (Baisas 1974).

Observations: Predominant species all over the district. Encountered in pit shelter and out of doors in a variety of places namely bushes, vegetation, bamboo fences, fence crevices and underneath logs. It must be recognised that the result of investigations in one geographical area are not necessarily valid when applied to another population of the same subspecies in a different geographical area (Bram 1967).

Culex (Culex) gelidus Theobald, 1901

Specimens collected: Kotamsar 3 fm; Tirathgarh 4 fm; Mamadpal 2 m, 3 fm; Darbha 2 m, 6 fm; Bispur 1 fm; Kukalgur 1 m, 2 fm; Sat Dhar 1 m, 2 fm; Aghanpur 3 m, 8 fm; Useli 4 m, 1 fm: Total 13 m, 30 fm.

Distribution: Recorded in the North-Eastern plateau; Tinkanpalli hills, Indravati plains. Baisas (1974) reported distribution from Malaysia, Singapore, Indonesia, New Guinea, Philippines, Taiwan, Japan, China, Vietnam (N & S) Cambodia, Laos, Thailand, Burma, Nepal, India, Pakistan and Sri Lanka.

Altitudes: Recorded between 304 and 761 m a.s.l. Scanlon and Esah as quoted by Bram (1967) collected *gelidus* females biting man from 4,572 to 13,716 m of elevation on a mountain in Chiang Mai.

Seasonal prevalence: Collected in July, October to December in hot-moist, moderately hot-moist and hot-wet climatic regions.

Biting habits: Eleven females were secured from human bait. Baisas (1974) stated this mosquito as zoophilic. Bram (1967) reported that adult females are vicious biters but feed on man only in the absence of other suitable hosts.

Observations: Collected from bushes near stream, in tree holes and in pit shelter. Recorded in forest at higher altitudes. Joshi *et al.* (1965) secured three females from houses and three examples from pit shelter. Peters and Dewar (1956) found adults in native dwellings, cattlesheds and in tents in Nepal.

Culex (Culex) tritaeniorhynchus Giles, 1901

Specimens collected: Darbha 2 m, 5 fm; Kotamsar 3 m, 1 fm; Mamadpal 1 m, 2 fm; Mangnar 3 fm; Kukalgur 8 m 6 fm; Bispur 1 fm; Kamanar 4 m, 11 fm: Total 18 m, 29 fm.

Distribution: Recorded in the North-Eastern plateau and Indravati plains of Bastar district. Bram (1967) reported distribution throughout Thailand, India, Sri Lanka, Maldive Islands, Malagasy, Tanzania, Kenya, Ubangishari, Nigeria, Benin, Togo, Senegal, Egypt, Israel, Lebanon, Syria, Turkey, Iraq, Iran, Turkmen S.S.R., Philippines, Taiwan, Ryukyu-Retto, Japan, Korea, China, Indochina, Indonesia, Malaya and Maritime province, U.S.S.R.

Altitudes: 304 to 761 m a.s.l. Scanlon and Esah as quoted by Bram (1967) collected females biting man at elevation up to 1,372 m in Chiang Mai.

Seasonal prevalence: Collected in July, September and November in the hot-moist and hot-wet climatic regions.

Biting habits: On human bait, 17 females were captured. Baisas (1974) reported that this mosquito is largely zoophilic, a certain percentage bite human beings and so this mosquito becomes the object of interest and study in connection with Japanese 'B' encephalitis and other diseases of man.

Observations: Recorded in forests at higher altitudes and in pit shelter. Nakao as quoted by Bram (1967) suggested that *C. tritaeniorhynchus* may be an indoor resting species. Specimens of *C. tritaeniorhynchus* were secured in tree holes, underneath logs, and from bushes in the courtyard of the hutments. Joshi *et al.* (1965) captured one female from pit shelter, six females from outdoors and three females inside house in Nepal.

Culex (Lutzia) vorax (Edwards), 1921

Specimens collected: Kotamsar 1 fm; Kamanar 7 fm; Mangnar 6 m; Darbha 1 m, 2 fm; Kukalgur 1 m, 1 fm; Adhawal 3 m, 1 fm; Useli 8 fm, Mamadaptl 3 m, 5 fm: Total 14 m, 25 fm.

Distribution: Recorded in the Indravati Plains and North-Eastern Plateau.

Altitudes: 457 to 761 m a.s.l.

Seasonal prevalence: Collected in June, July, September to November in the moderately hot-moist and hot-wet climatic regions.

Observations: This mosquito was taken in bushes in forests (Kotamsar); tree holes (Useli), underneath logs and from tall grass.

Culex (Culex) 'vishnui' Theobald, 1901 Group

Specimens collected: Mamadpal 1 fm; Darbha 11 m, 35 fm; Etpal 14 m, 3 fm; Adhawal 3 m, 2 fm: Total 28 m, 41 fm.

Distribution: Recorded in the North-Eastern plateau, Indravati plains and Godavari Sabri lowlands.

Altitudes: 48.5 to 761 m a.s.l.

Seasonal prevalence: Collected in Feb., Sept. to Dec. in the hot-wet, hot-moist and very hot-moist climatic region.

Biting habits: A total of 32 females were taken on human bait.

Observations: Specimens of this species were encountered in grass in the vicinity of hutments; fences along side rice fields, bushes in courtyards and from pit shelter.

Genus: *Mansonia* Blanchard 1901

Mansonia (Mansonioides) annulifera (Theobald), 1901

Specimens collected: Kotamsar 3 fm; Kamanar 3 fm; Darbha 3 m, 2 fm; Kesaiguda 1 m, 2 fm; Kukalgur 4 m, 2 fm; Useli 2 m, 3 fm; Aghanpur 2 m, 3 fm; Bispur 3 fm; Hat Kachora 3 m, 6 fm: Total 15 m, 27 fm.

Distribution: Recorded in the Indravati plains, North-Eastern plateau and Dantewara plains. Baisas (1974) quoted distribution in Philippines (Mt. Province, Sorsogen, Leyte, Olongapo Zambales, Manila and Rizal), Ethiopia, Oriental and Australian regions, Solomon Islands, Japan and Ryukyu-Retto.

Altitudes: Between 48.5 and 761 m a.s.l.

Seasonal prevalence: Collected in Jan., Feb., May, July to Sept. and Nov. in the hot-wet, hot-moist and moderately hot-moist climatic regions.

Biting habits: Not secured on human bait. Baisas (1974) reported it as both zoophilic and anthropophilic. Specimens were collected in Carabao-baited traps, a few were caught while biting man in late afternoon (Baisas 1974).

Observations: *M. annulifera* was encountered in bushes near perennial stream, in pit shelter and fences along side rice fields. Joshi *et al.* (1965) encountered this mosquito inside house in Nepal.

Mansonia (Mansonioides) uniformis (Theobald), 1901

Specimens collected: Ban Usri 1 m, 1 fm; Darbha 4 fm; Tirathgarh 1 m, 3 fm; Kotamsar 2 fm; Kukalgur 3 fm; Kesaiguda 2 m, 2 fm; Bispur 7 fm, Adhawal 3 m, 3 fm: Total 7 m, 25 fm.

Distribution: Recorded in the North-Eastern plateau, Indravati plains and Dantewara plains. Baisas (1974) reported distribution from Philippines, South-East Asia, Indonesia and Thailand.

Altitudes: 152 to 761 m a.s.l.

Seasonal prevalence: Collected in May, July to December in the hot-moist and hot-wet climatic regions.

Biting habits: Nine females were secured on human bait. Baisas (1974) described it as largely zoophilic, seldom anthropophilic.

Observations: Specimens were secured in a tree hole at a height of 1.2 m above the ground. Encountered in pit shelter, bushes near ponds and from vegetation out of doors. Joshi *et al.* (1965) collected *M. uniformis* inside house in Nepal.

Genus: *Armigeres* Theobald 1901

Armigeres (Armigeres) subalbatus (Coquillett), 1898

Specimens collected: Mangnar 9 m, 1 fm; Kukalgur 4 fm; Darbha 3 m, 7 fm; Adhawal 2 m; Kesaiguda 4 fm, Ban Usri 2 fm: Total 14 m, 18 fm.

Distribution: Recorded in the Indravati plains, the Southern plateau and the North-Eastern plateau of Bastar district. Baisas (1974) reported distribution from Philippines, Indonesia, Malaysia, and Japan.

Altitudes: 152 to 761 m a.s.l.

Biting habits: Not taken on human bait. Baisas (1974) indicated that this mosquito is seldom anthropophilic.

Seasonal prevalence: Collected in March, July, Sept. and Oct. in hot-wet and hot-moist climatic regions.

Observations: Specimens were taken in the bushes near a stream, tree holes and fences of rice fields having tall grass. Joshi *et al.* (1965) took six females from jungle and two females from inside houses in Nepal. Baisas (1974) reported that *A. subalbatus* usually breeds in cut bamboos, sometimes in coconut shells and artificial containers.

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REFERENCES

BAISAS, F. E. (1974): The Mosquito fauna of subic Bay Naval Reservation. *Tech Rpt. No. 72-2 hq. First Med. Ser. Wing (PACAF), APO San Fransisco,* 170 pp.

BRAM, R. A. (1967): Contributions to the Mosquito fauna of Southeast Asia. II—The genus *Culex* in Thailand (Diptera: Culicidae). *Contr. Amer. Ent. Inst. 2* (1): 1-296.

HUANG, YIAU-MIN (1972): Contributions to the mosquito fauna of Southeast Asia XIV. The subgenus *Stegomyia* of *Aedes* in Southeast Asia. I. The *Scutellaris* group of species. *Contr. Amer. Ent. Inst. 9*(1): 1-109.

JOSHI, G., PRADHAN, S. AND DARSIE, R. F. (1965): Culicine, Sebathine and Toxorhynchitine Mosquitoes of Nepal including New country records. *Proc. Ent. Soc. Wash., 67*(3): 137-146.

PETERS, W. AND DEWAR, S. C. (1956): A preliminary record of the Megarhine and Culicine mosquitoes of Nepal with notes on their taxonomy (Diptera: Culicidae). *Ind. J. Mal. 10*(1): 37-51.

PRAKASH, R. AND HUSAINY, ZAKIR HUSAIN (1974): Studies on the Anopheline Mosquitoes of Bastar District (Madhya Pradesh). Pt. I. Distribution Pattern of Adults. *The Annals of Zool., 10*(2): 13-52.

STONE, A., KNIGHT, K. L. AND STRAKE, H. (1959): A Synoptic Catalogue of the Mosquitoes of the World (Diptera: Culicidae). *Ent. Soc. Amer. Thomas* Say Found., Vol. VI, 358 pp.

NOTES ON THE FEEDING AND HUNTING BEHAVIOUR OF LION-TAILED MACAQUES (*MACACA SILENUS*) IN CAPTIVITY[1]

Y. ARTAUD[2]

INTRODUCTION

These notes come from the continuous observation of a small group of lion-tailed macaques in captivity since 1970. Most of the facts reported however within the limits imposed by the title, belong to the year 1977, after the monkeys had been transferred from the urban zone to the countryside near Pondicherry. There they have shown an evolution of their dietary habits, mainly due to the richness of the vegetal and animal life of their new habitat as compared to the old.

A vast garden now surrounds and prolongates the monkeys' house. Beside it a pond grows papyrus within their reach, which explains the coming of visiting frogs inside the cages. There is the possibility for some of our monkeys to be taken into the garden where they can choose from a wider variety of food than is normally put at their disposal.

The group, in 1978, was composed of a 9-year-old male, a 9-year-old female and their one-year-old infant, together with a 7-year-old female. They live in a compound of three communicating cages. The five-metre high central cage, protected from sun and rain, is adjacent to and entirely visible from the two-floor abode of the observer. This is where the females spend more than half of the day and where the entire group retires at night. A floodlamp projecting a soft artificial moonlight captured by the pale grey beard of the lion-tailed macaques, permits observation at night.

FEEDING BEHAVIOUR

When we started our observation of lion-tailed macaques in captivity, we soon noticed their great need of animal proteins, compared to that of the bonnet macaque (*Macaca radiata*) which we also study in our centre. An adult lion-tailed macaque male lent us for one day in 1969 from an itinerant zoo, chose fish first (we did not offer him meat) from a plate with varied samples of food, asked several times for more and ate practically nothing else except grapes. When the second of our lion-tailed females, then 4 months old, arrived at our centre at the beginning of 1972, she disregarded the food put before her, including milk, cereals, several varieties of fruits and fresh vegetables. Instead she stole meat from the dogs. That need can be expressed so vividly when they smell or foresee the possibility of getting some cooked meat or fish, that we have baptised its vocal expression "the protein cry". But it is only recently that we have witnessed some of their hunting practices.

The following parts of this article might give the impression that our monkeys are

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[1] Accepted December 1978.

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undernourished. That is why we have first to explain that they are fed according to advice given by European and American zoos. They get, season by season, all the varieties of vegetal food available in the Pondicherry market, besides plants, flowers and leaves from the garden, and a cereal pudding with calcium and vitamin supplements. Some of the items they like to have daily, such as tomatoes, lady fingers, guavas, grapes and a local plant called in Tamil *kirai*. For years they have received also twice a week a supplement of animal proteins. But it has been increased in quantity and frequency since we discovered their propensity for hunting. The male eats approximately 100 grams of liver, 100 grams of buffalo meat, some crab or fish and half an egg per week.

Natural Animal food:

As we have already explained, some of our monkeys are taken regularly through the garden and eat whatever they like. Small animals happen also to visit their cages and the monkeys catch them.

Frogs: On 15 January 1977 at 10 p.m. we noticed an unusual activity. While the females remained on their sleeping plank, the male was sitting on the floor, his back turned to us, eating a frog. Acknowledging our presence, he showed us his prey and continued eating with obvious satisfaction. Following this event, we focussed our observations on the beginning of the night period. The same scene occurred on the 27th, 28th, 29th and 30th of the same month. On the 30th, the male even succeeded in capturing three frogs at a time and kept one in one foot while eating the two others.

We did not wait long to start increasing the amount of proteins alloted to our small colony, but this did not seem to curb the appetite of our male lion-tailed macaque for living frogs. All year long he goes around after nightfall inspecting his premises. If he finds some frog, he likes picking it up and chewing it leisurely.

The females are not permitted to hunt in his presence. Only three times have we seen them capturing and eating frogs inside the cage, when the male was busy with some other occupation, twice in day time and once at the beginning of the night. But while separated from the male and taking a walk in the garden, the females know where to find frogs in palm-roofed pavilions. On 14 June 1977, we saw the older female fishing a frog directly out of the pond and devouring it on the spot.

Snails: In the garden, the females some times eat snails. They do not automatically pick up a snail whenever they see one. During a period of three months of daily walks in the garden, from the middle of June to the middle of September 1977, we counted that the older female must have eaten about a dozen snails. On two occasions, she ate 3 or 4 at a time.

Insects: Insects are common food for the lion-tailed macaques. They consume a large variety of them—including house spiders, cockroaches and white ants—when they have the opportunity to do so. In the daily ration of fresh plants and small branches put inside their cages, they always look for insects before looking for buds. They also eat several varieties of water bugs and crunch them with delight. But only the male has been seen to make a feast out of giant Belostomatidae, unappetising for his companions. When they forage in the garden, they often pick up at the same time with insects, pieces of grass or leaves. It may be quicker to capture them that way, but it also seems to be a desired mixture.

Eggs: Wherever possible, the females also rob birds' nests, but they have never eaten birds, not even those which happened to enter their cages, though they killed two of them by trying to chase them away or to play with them.

Reptiles: During her pregnancy, the older female became a keen and skillful hunter. She looked not only for insects but also for bigger prey. On 19 June 1977 we saw her for the first time capturing and eating entirely a large Indian Bloodsucker lizard (*Calotes versicolor*). Within the three months of her maximal hunting activities she ate 9 of them and missed 2. A huge one bit her fingers two times and she let it go. Another one she wounded before it could escape her. Other smaller varieties of lizards are also eaten, but only partly.

Finally we discovered that lion-tailed macaques attack and eat snakes.

Feeding behaviour of the alpha:

The rights of the chief.

As the *princeps*, he is the one who takes and eats first whatever he likes. His choice is quickly made; after that he retires a little to give the others their turn. A titbit of food distributed outside the schedule, which someone manages to get before the chief, is usually not contested by him, though the others do not hide their pleasure and vocalise it with a special sound which means "How good!" His permissiveness varies with the degree of rarity of the food, its dietetic value and the distance at which the misdeed happens—the nearest the most reprehensible. But his attacks do not actually injure anyone. Animal proteins are considered by him to be his exclusive property. When we distribute liver, for example, we have to separate the chief from the others. And hunting in his presence is absolutely prohibited.

Ritualistic behaviour:

From time to time our monkeys are given a complete coconut to peel off and open. One day, in front of several spectators, the chief had worked for ten or fifteen minutes with his four hands and teeth and the entire musculature of his body to remove the thick coat of fibers that cushions the wooden shell. He rejected the last mouthful of fibers and looked at the coconut. Usually he tries to break the shell before the peeling is over. But that day he had carefully stripped the entire nut, which was now lying at his feet. He looked at it, seized it with both hands, stood up and held it high above his head, his gaze fixed on it. Then he turned slowly around 3 or 4 times, lowered the coconut to his chest, held it with a single hand and in a few jumps reached the top of the 5 metre cage. From there he looked to be sure that nobody was standing just below, and let the coconut drop to the floor. One second later he was drinking the water from the open fruit. A few minutes afterwards everybody had a piece of it.

Changes brought about by the birth of a young:

After the birth of the first young, a change occurred in the feeding behaviour of the alpha. He often gave precedence to the mother to go from one cage to another where some simple food had been placed. He regularly turned his back and looked somewhere else when we offered a special food every morning to the females. He let them eat first, on the highest level of the cage, together with the baby, while he sat on the floor, sometimes picking up what they had let drop, waiting for us to come down to give him his share. His tolerance was limited to a few given situations. But it did not lessen today, when the child is nearly one year old. The restraint imposed on his huge body and exhuberant if not explosive vitality by the presence of the child is amazing to observe.

The second female plays the role of the elder sister. When the infant started to eat, she shared her part of the food with it, so giving the nursing mother more chance to fulfil her energy needs.

Now the child goes freely outside the sage and serves in a liaison capacity, bringing to the other monkeys desired items, such as bones abandoned by the dogs or pieces of brick, which are very much appreciated.

HUNTING BEHAVIOUR

Monkey-snake encounters:

On 11 April 1977, a snake some 80 centimetres long had entered the central cage. When we became aware of it, the male lion-tailed macaque had already taken hold of it at a few centimetres from the head. With precision and skill, he prevented the snake from turning towards him. He stood in a bipedal position, the right arm fully extended, holding the snake. The left hand remained free. His whole attitude reminded us of a fencer fending off the attacks of his adversary. What happened next went so fast that we were not able to perceive it. The monkey reached the middle floor level of the cage and suddenly the snake had lost 10 centimetres or more of its tail. Then the male macaque disappeared with the snake towards the highest level of the cage. He soon came down empty-handed. We asked him: "Where is the snake?" He reached with his fingers into his mouth and laboriously extracted the dead snake from one of his cheek-pouches to show it to us and then carefully put it back. The distended pouch was not visible behind his large facial ruff. A little later the second female ate the tail that she had secured for herself and the male ate all the rest of the animal.

In January 1978, we discovered the male holding a snake again, this time in his left hand. It was the size of a viper and we gave the danger signal. He let it drop and the snake found its way out.

Recently, we observed the beginning of a fight between the same lion-tailed macaque male and another visiting snake. The monkey had trapped the snake in a corner of the cage and was manoeuvring to catch it. The snake was facing the monkey and it suddenly lunged towards him in a lightning attack. The macaque avoided the snake with a minimum of movement and resumed his approach. Some outside event interrupted the fight and the snake disappeared.

Replacement behaviour:

The intrepid behaviour of the captive lion-tailed macaque male confronted for the first time by a snake, contradicts apparantly his cautious behaviour in front of unknown animals or moving toys. Even a new wooden ball introduced into his cage, which rolled on the sloping floor—and though he has been playing with wooden balls before and can recognise one at once—became the object of a test performance, leading to its identification and classification.

He approached the ball with a commanding gesture to keep everybody at a distance, and covered it with a leafy branch. He started rolling the object vigorously to and fro on the floor, using the leaves as a protective layer. He bent to the ground to try to see the ball and pushed it around, always under the leaves, to observe its reactions. As nothing happened, he parted the leaves, smelled the ball from a distance, pushed it a little with the branch and finally touched it directly with his fingers. He bent, sniffed it again and put his mouth on it. Only then did he start manipulating it freely and tasting a scrap on it.

This special hunting behaviour brought about by a new ball or whatever new or unknown thing that moves by itself, evidently gives him time to examine it and if possible take hold of it. He exhibited the same kind of behaviour, in an abridged form, in evaluating the quality of a tree frog whose skin had turned whitish. He finally pushed it outside the cage with a branch without touching it.

Killing techniques:

We never saw the females going through this elaborate testing process, which seems to belong to the function of the chief. However all of them roll insects under or between their naked hands or against the bark of a tree, or sometimes with the back of the hand which is covered with hairs. In some cases they also use leaves as a protection. But they most often put insects directly into their mouth without preparatory manipulation. When they eat snails, they crunch the shell with the teeth or by rolling it against something. They remove the anal end. When the manipulation is finished, they clean their sticky hands against some grass or bark.

The killing becomes more dramatic when the technique of rolling the insects is applied to frogs and this is how the male generally operates. He almost lost one of his first victims, which jumped away partly eaten, but he caught it again in the semi-darkness and finished eating it.

The females seem to be better killers. They bite the animal at the head or open its belly. When we saw for the first time the older female killing an Indian Bloodsucker lizard, she seemed in possession of a perfect technique. She seized the animal by its upper part and, with lightning speed and strength, bit its head and ate it immediately. Her next choice was the tail, followed by the thighs. She then opened its belly, threw away the anal part and ate the rest of the contents. Then she sat down more comfortably, peeled the skin off, let it drop, and ate practically the entire body except for the front legs.

DISCUSSION

Living under the same roof with a group of monkeys, in a proximity which makes observation possible day and night, permits the discovery of behavioral traits difficult to observe otherwise. The many-faceted lion-tailed macaque—a rare and little known monkey—shows here its ingeniousness, its capacity for adaptation and change and its nearness to man particularly in the way its society reacts to the birth of a child.

SUMMARY

The lion-tailed macaques in captivity, that we have observed since 1970, have demonstrated a great need for animal proteins and a natural taste for living food. If given the opportunity, they capture insects, snails, frogs, lizards and even snakes and rob birds' nests. Their way of killing and their dietary tastes are rather individual and adapted to circumstances. We did not see them attacking birds or small mammals with a view to feeding on them. But they eagerly eat boiled meat, fish, crab and even bones. The chief of the group has been seen to go through some kind of ritual performance to celebrate the opening of a coconut and to evaluate the potential danger or food value of some moving thing or unknown animal.

These facts have been gathered in an environment which gives the facilities of close and constant observation and provides at the same time enough stimulation and freedom to the monkeys to deploy their native psychological capacities.

NEW DESCRIPTIONS

ON A NEW SILURID CAT-FISH FROM UTTAR PRADESH, INDIA[1]

S. K. Gupta,[2] K. C. Jayaram[3] and K. P. Hajela

(With a text-figure)

INTRODUCTION

During the course of faunistic and ecological studies of the fishes in and around Kanpur, Uttar Pradesh, India, three specimens of a new cat-fish of the family Siluridae were collected. The specimens are akin to *Wallago attu* (Bloch) but differ from it in possessing a second rayed dorsal fin, not confluent with caudal and for that matter from all other forms of the superfamily Siluroidae where the smooth adipose dorsal fin is not so uncommon. After examination of the specimens and on comparison with the material present in the National Zoological Collections in Zoological Survey of India, Calcutta, (by one of us KCJ), it was thought fit to describe it as a new genus of Silurid cat-fish.

This paper presents the description of this new fish.

Pinniwallago gen. nov.

Similar to *Wallago* Bleeker but distinguishable from it by the presence of second dorsal rayed fin without spines. All other characters as in the type-species.

Pinniwallago kanpurensis sp. nov.

(Fig. 1)

B. 21; D_1 5-6; D_2 30-36; P. 1/14; V. 10; A. 84-89 (4/80-85); C. 18. Body depth 5.2 (4.8-5.5); head length 4.43 (4.2-4.6); head width 7.73 (7.7-7.8); head depth 7.7 (7.4-8.1); pre-dorsal length 3.3 (3.29-3.31); post-dorsal length 1.42 (1.42-1.43); pre-pelvic distance 2.7 (2.5-2.9); in standard length. Eye 8.0 (7.9-8.1) in head length; 3.60 (3.45-3.72) in inter-orbital space width; 3.11 (2.81-3.27) in snout length. Width of base of first dorsal fin 9.9 (9.0-10.8); width of base of second dorsal fin 1.21 (0.90-1.57) in head length. Least depth of caudal peduncle 0.43 (0.40-0.47) in its length.

Body elongate, compressed. Head broad, large, depressed. Snout depressed, sharp but not pointed. Eyes large, inferior, visible from below ventral surface. Mouth large, gape extending beyond eyes. Jaws subequal, lower jaw slightly longer than upper with numerous depressible cardiform teeth; an oblique vomerine patch on either side, palatines without teeth.

Barbels two pairs, one each of maxillary and mandibular; former thick reaching slightly beyond origin of anal fin, latter thin, filamentous extending to a distance slightly posterior to the eye. Two dorsal spineless fins,

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[1] Accepted March 1980.

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first short with five or six rays, second long with 30 to 36 rays and widely apart from caudal fin. Pectoral fin short with a spine. Anal fin long, ending near caudal fin but not confluent with it. Caudal fin forked with rounded lobes. Lateral line simple and complete.

Fresh specimens greyish with a yellow tinge along the back; sides and belly, yellow. First and second dorsal, caudal and anal, grey; ventral, yellow, blending with sides and belly coloration. Alcohol preserved specimens dark grey along upper half of body and anal fin base, light grey along ventral half.

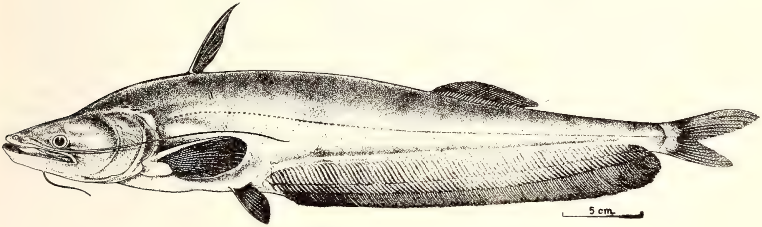

Fig. 1. *Pinniwallago kanpurensis* sp. nov.

Distribution: Ponds in and around Kanpur, Uttar Pradesh, India. All known specimens were collected from 'Bara Tal' near village Bhitargaon, Tehsil Ghatampur, District Kanpur.

Holotype: in Z.S.I., Calcutta, collected on 27-6-1976 from above locality; F.F. 1443.

Paratypes: Two, one in Z.S.I., Calcutta, F.F. 1444 and the other in the museum of Zoology Department, D.A.V. College, Kanpur, collected on 5-vii-1976 from above locality.

Affinity: This new species is undoubtedly related to the widely distributed *Wallago attu* from which it differs in having the second rayed dorsal fin.

Discussion: In Indian Siluroid fishes, the second dorsal fin whenever present, is smooth and adipose except in the genera *Choca* Gray and *Plotosus* Lacépède where the second dorsal is rayed but confluent with the caudal. Jayaram (1966),[4] while discussing the affinities of the genus *Clarotes* Kner of the family Bagridae from Africa, pointed out the unique modification of the adipose dorsal fin as a fin with rays and spines which justified the provision of a generic rank for the African fish. Phylogenetically *Wallago* is primitive and the new genus can be stated to be slightly better evolved in possessing the second rayed dorsal fin.

The species is named after Kanpur, India from where it has been first reported.

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[4] Jayaram, K. C. (1966): Contribution to the study of the Fishes of the family Bagridae. 2. A systematic account of the African genera with a new classification of the family. *Bulletin de i' Institut Fontamental d' Afrique Noire*. Tome xxviii, Ser. A. n 3 tuillet pp. 1094-1095.

ON A NEW SPECIES OF GENUS *ALLOTRISSOCLADIUS* FREEMAN (DIPTERA, CHIRONOMIDAE) FROM INDIA[1]

P. K. CHAUDHURI AND S. K. NANDI[2]

(*With three text-figures*)

In course of our studies on the Chironomid midges of India, a few specimens of genus *Allotrissocladius* Freeman were noticed amongst collections of insects from Darjeeling, West Bengal, India. The insects at first sight seem to be members of the genus *Paratrissocladius* Zavrel but close examination of characters especially the presence of accessory appendages in male hypopygium, assigns them to the genus *Allotrissocladius*. The genus was first proposed by Freeman (1964) on the basis of specimens from Western Australia and *Allotrissocladius amphibius* Freeman was the type-species.

The descriptions and terminologies used in this paper have been followed after the works of Saether (1976).

Allotrissocladius acutus sp. nov.

Male: Body length 3.38 (3.34-3.39, n = 6) mm; wing length 1.72 (1.68-1.74, n = 6) mm; Wing breadth 0.53 (0.52-0.53, n = 6) mm.

Head: Brown in colour. Vertex brown with 6-10 setae of which 2 being postocular on each side. Clypeus with 4 setae in transverse row. Maxillary palp light brown, palpomere III with a small preapical pit bearing 1-2 sensilla, palpomere V with an apical seta, ratio of length of palpomeres from I to V 8:13:32: 26:45, L/W ratio 4.0. Eyes reniform, bare and slightly extended dorsally, extension being 0.1 mm. Antenna pale, flagellomeres cylindrical, flagellomere XIII lance-shaped, ratio of length of flagellomeres from I to XIII 8:7:8:8:10:11:11:10:10:11:13:12 : 91, AR 0.76.

Thorax: Antepronotum with 1 lateral seta. Acrostichals 4-6 (6), dorsocentrals 10 in a row on each side, prealars 4, prescutellars 2 on each side. Scutellum with 4 setae on each side, postscutellum brown with dark margin.

Wing (Fig. 1): wing without macrotrichia, microtrichia visible in high magnification. Brachiolum with 1 seta, R with 14-15 (14) setae from the base, R_1 and R_{4+5} with out setae; R_{2+3} ends C at a distance of 0.19 mm from R_1, R_{4+5} ends slightly proximal to M_{3+4}, C extended little beyond R_{4+5} being 0.04 mm long, f-cu considerably distal to r-m, Cu_1 straight and slightly bent at the apex, ends slightly proximal to f-cu. Sensory organ 1 each r-m and at the base of R_1. Squama with 12 setae. Anal lobe well developed and produced. Haltere pale. VR 1.1, CR 0.93.

Legs: uniformly brown. Spur of fore tibia 0.06 mm long, ratio of length of spur to the apical diameter of fore tibia 5:9; spurs of mid tibia equal 0.32 mm long, ratio of length of spur to the apical diameter of mid tibia 8:10; spurs of hind tibia unequal 0.076 mm and 0.032 mm long, ratio of length of spurs to the apical diameter of hind tibia 18:12, 8:12. Hind tibial comb with 12 setae, 0.028-0.056 mm long. Claws of hind leg equal, curved 0.028 mm long with 2 setae at the base. Empodium smaller than claws. LR 0.47 in fore leg, 0.56 in mid leg and 0.58 in hind leg. TR of hind leg 1.78.

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[1] Accepted May 1979.

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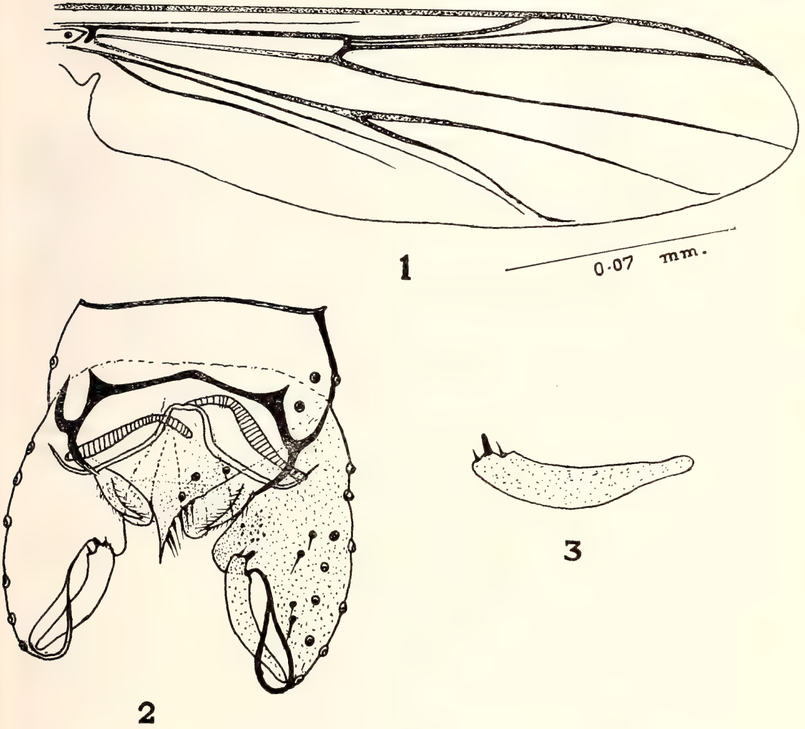
Abdomen: Terga ochreous, tergum I with 15-16 lateral setae, terga II to VIII mottled brown with numerous setae. Hypopygium (Fig. 2). Anal point narrow and pointed bearing 5-6 (6) setae on each side. Gonocoxite with a thumb like basal lobe, gonocoxite with 24-26 setae; gonostylus (Fig. 3) slightly bent at the middle, base narrow and distal part wider with an apical tooth 0.012 mm long and a seta on each side of tooth. Appendage two in number, outer one narrow, profusely setaceous and inner one broad. HR 2.2, HV 3.9.

Material: 6 males were collected by the senior author from the Govt. College, Dar-



Figs. 1-3. *Allotrissocladius acutus* sp. nov. 1. wing; 2. hypopygium and 3. gonostylus.

jeeling in May, 1970. Holotype male (Type no. 60, B.U .Ent.) in the collections of insects at the department of Zoology, University of Burdwan, Burdwan.

Female: unknown.

The present species has been named *Allotrissocladius acutus* sp. nov. in view of its narrow and pointed anal point. The species shows close similarities with *A. amphibius* Freeman from West Australia in some aspects but the differences in the setae of thorax, wing with its venation and structure of male hypopygium are sufficient to treat the species as a new one.

ACKNOWLEDGEMENTS

We are grateful to Prof. Ole A. Saether of the University of Bergen (Norway) for kindly confirming the species and going through the manuscript and to Prof. D. K. Choudhuri, Head of the department of Zoology, University of Burdwan for laboratory facilities.

REFERENCES

FREEMAN, P. (1964): Notes on Chironomidae (Diptera; Nematocera). *Proc. R. Ent. Soc.*, London (B) *33*: 147-150.

SAETHER, O. A. (1976): Revision of *Hydrobaenus, Trissocladius, Zalutschia, Paratrissocladius* and some related genera (Chironomidae, Diptera). *Bull. Fish. Res. Bd.*, Canada *195*: 1-287.

A NEW SPECIES OF THE GENUS *HERCULIA* WALKER FROM NORTH INDIA (LEPIDOPTERA: PYRALIDAE: PYRALINAE)[1]

H. S. ROSE AND S. S. DHILLON[2]

(*With seven text-figures*)

During an extensive survey of Pyralid moths of North India, we collected six species belonging to the subfamily Pyralinae. These six species included two new species, one of which has been already described (Rose and Pajni 1978). The second species, according to Hampson's key (1896), is clearly referable to the genus *Herculia* Walker, which includes fourteen other species from India. The species under reference is distinctly different from all other *Herculia* spp. (Hampson 1896a, 1896b, 1916, 1917) and hence, is being described as a new species. The nomenclature of Klots (1970) has been followed for genitalic structures.

Genus *Herculia* Walker

Herculia Walker, 1859, *Cat. Lep. Het. Brit. Mus., 19*: 807. Type species: *Herculia marthalis* Walker (Range: Universally distributed).

Herculia hansi sp. nov. (Figs. 1-7)

Head: Vertex covered with densely arranged long and ochreous scale; frons profusely scaled with ochreous brown scales. *Antenna*: shorter than fore wing; scape over laden with brown scales; flagellum annulated and finely ringed with fusco- rufous and pale brown scales; minutely pilose and without any bran-

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[1] Accepted January 1980.

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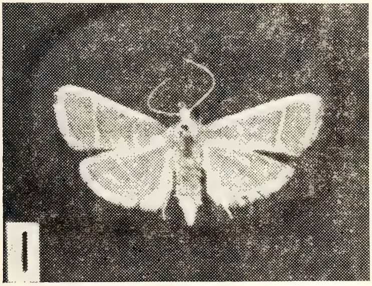
ches in male. *Eye*: large, with a row of greyish brown scales behind. Ocellus absent.

Labial palpus: upturned; second segment long, reaching vertex of head; third segment porrect, short and acuminate; all segments thickly scaled with brown scales, irrorated with fuscous and fulvo-rufous scales. *Maxillary palpus*: reduced and filiform, covered with light brown scales. *Proboscis*: long, furnished with fuscous brown scales at base. Posterior end of head densely clothed with ochreous brown scales.



Herculia hansi sp. nov.
Fig. 1. Photograph of the adult.

Thorax: covered with dull green scales dorsally; scales on tegula reaching beyond metathorax; white ventrally.

Fore wing: Anterior margin straight; apex rounded; termen evenly curved; tornus rounded; posterior margin straight. Ground colour dull green, uniformly and finely irrorated with white scales; the costal margin yellowish brown; a slightly curved white antemedial line from costa to inner margin; an inwardly oblique and straight white postmedial line from costa to anal margin; margin whitish; marginal fringe greyish. Discal cell shorter than half the length of wing. Sc straight; R_1 free, from anterior angle of cell; R_2 free; R_3, R_4 and R_5 stalked; M_1 from base of $R_3+_4+_5$; M_2 and M_3 from posterior angle of cell, closely approximated at origin for sufficient distance, diverging distally; Cu_1 weakly curved towards base of M_3; Cu_2 from cell at about two-third the length of cell; 3A making a small loop at base of 2 A.

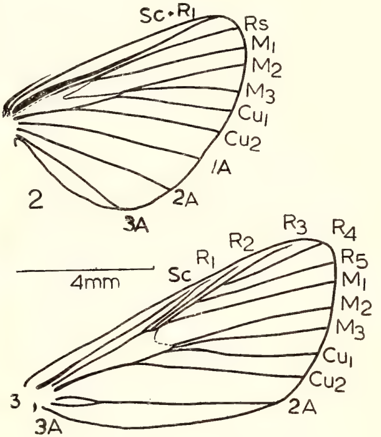
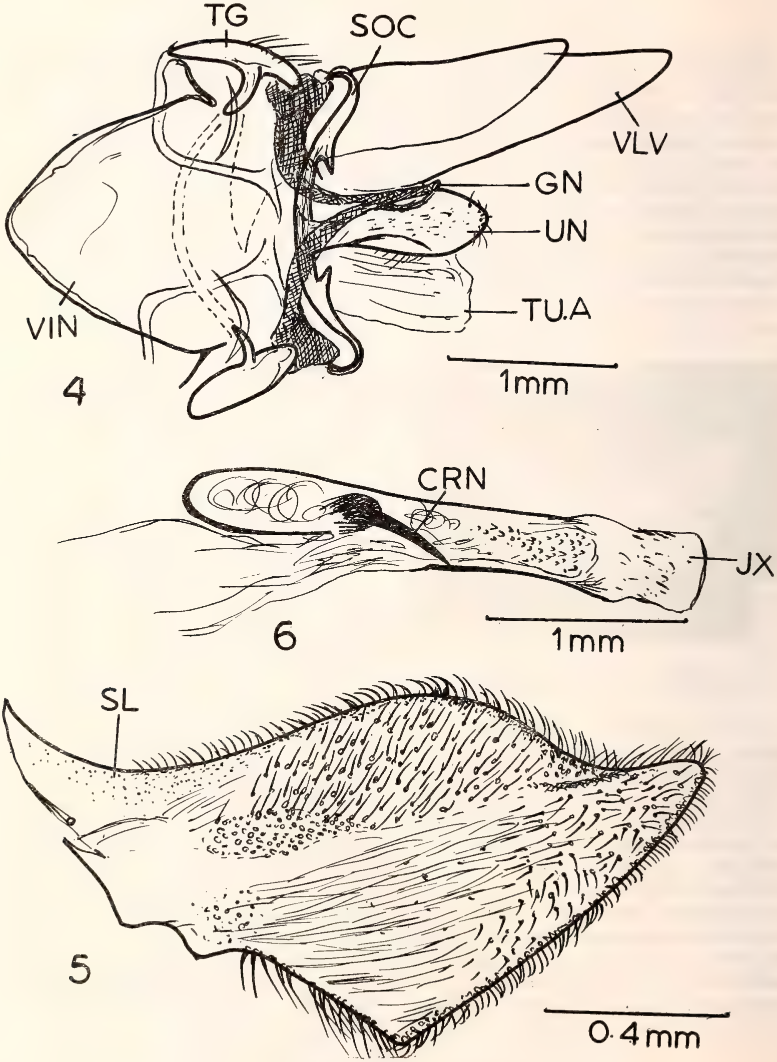


Fig. 2. Fore wing. Fig. 3. Hind wing.
Abbreviations:
1A, First anal vein; 2A, Second anal vein; 3A, Third anal vein; Cu_1, First cubital vein; Cu_2, Second cubital vein; M_1, First median vein; M_2, Second median vein; M_3, Third median vein; R_1, First radial vein; R_2, Second radial vein; R_3, Third radial vein; R_4, Fourth radial vein; R_5, Fifth radial vein; Rs, Radial sector; Sc, Subcosta; Sc. R_1, Stalk of Sc and R_1.

Hind wing: Costal margin straight; apex, termen, tornus and anal margin rounded. Ground colour dull green, finely irrorated with white scales; a fine white antemedial line from


TG
SOC
VLV
GN
UN
TU.A
VIN
4
1mm
CRN
JX
6
1mm
SL
5
0·4mm

Figs. 4-6. Parts of male genitalia.
Abbreviations:
CRN, Cornutus; GN, Gnathos; JX, Juxta; SL, Sacculus; SOC, Socii; TG, Tegumen; TU.A, Tuba analis; UN, Uncus; VIN, Vinculum; VLV, Valva.

middle of cell to posterior margin; an inwardly oblique white postmedial line from $Sc+R_1$ to tornus; margin white; marginal fringe grey, with a dark line. Discal cell slightly less than half the length of wing; discocellulars long, straight and oblique; cell closed. Rs apposed to $Sc+R_1$ beyond cell for some distance; $Rs+M_1$ stalked; M_2 and M_3 from the same point at posterior angle of cell, approximated at base, diverging distally; Cu_1 diverging; Cu_2 from slightly beyond middle of cell; three anals present.

Legs: covered with brown scales, irrorated with fuscous and fusco-rufous; tibiae prominently and densely scaled; outer spur on mid tibia two-third the length of inner; outer spur of anterior pair on hind tibia exactly one-third the length of inner; outer spur of distal pair slightly less than half the length of inner.

Abdomen: brown dorsally, irrorated with dull green, poorly ringed with white, under surface ochreous brown.

Male genitalia: Uncus more or less slender, rounded distally, tip very minutely setose; socii quite prominent, long, each with an angular process, completely naked; gnathos well developed, shorter than uncus, strongly sclertized, its arms broad at base, meeting the distal end and drawn out into a short, more or less pointed process; tuba analis nearly as long as uncus, simple; tegumen reduced and well sclerotized; vinculum V-shaped; saccus rudimentary or absent. Valva moderately long, more or less boat-shaped, costal margin angulate, saccular margin arched, distal end narrow and rounded; costa not differentiated, sacculus very poorly demarcated at base only; harpe absent. Transtilla represented by a thin-strap; juxta more or less squarish. Aedeagus long and slender, its walls well sclerotized; vesica with a well developed long and thorn-

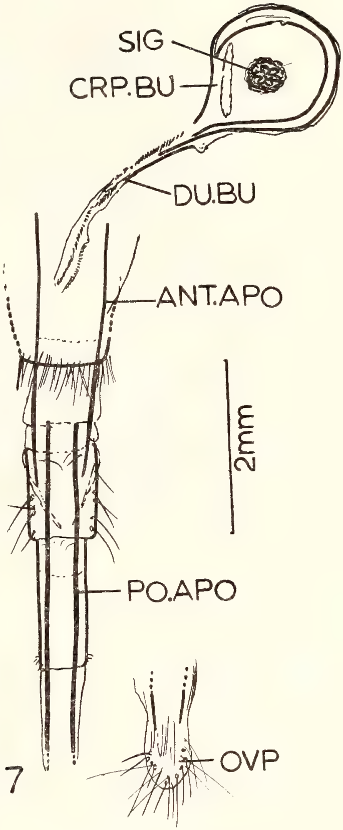


Fig. 7. Female genitalia.
Abbreviations:
ANT.APO, Anterior Apophyses; CRP.BU, Corpus Bursae; DU.BU, Ductus Bursae; OVP, Ovipositor; PO.APO, Posterior Apophyses; SIG, Signum.

like, strongly sclerotized cornutus and with a few loosely arranged denticles.

Female genitalia: Corpus bursae globular, membranous, lined by a sclerotized line on inner side; signum circular, well sclerotized and beautifully adorned with short denticles; ductus bursae membranous; anterior apophyses quite long, thin and well sclerotized; posterior apophyses much longer than anterior apophyses and slightly better sclerortized; ovipositor lobes more or less conical, each bearing short and long setae.

Alar expanse: Male: 20.5 mm to 23 mm
Female: 25.5 mm

Material Examined: Holotype: 1♂; 3♂♂ and 2♀♀ paratypes, India, Solan and Chambaghat (Himachal Pradesh) (Collected by HS Rose). Material deposited in the Department of Zoology, Punjabi University, Patiala-147002, Punjab, India.

Remarks: The genus *Herculia* Walker includes fourteen species, two of which namely *imbecilis* Moore and *dharmsalae* Butler have been described from North India (Hampson 1896a). The species under reference is, thus, the third species from North India which differs prominently from all the described species belonging to genus *Herculia*. The new species, *Herculia hansi*, however, shows slight similarity to *H. imbeciles* Moore in having an antemedial line on the dorsal surface of the fore wing while differing from it in lacking a dark speck at the end of the discal cell. The alar expanse of the latter is drastically larger (male 30 mm, female 34 mm) than as it occurs in the former (male 20.5 mm to 23 mm, female 25.5 mm.). The generic identity of *H. hansi* sp. nov. has been confirmed from the British Museum (Natural History), London.

ACKNOWLEDGEMENTS

We wish to thank Dr. J. D. Bradley of British Museum (Natural History), London for the confirmation of the species and Dr. Hans Raj Pajni, Department of Zoology, Panjab University, Chandigarh for his help in the preparation of this manuscript.

REFERENCES

HAMPSON, G. F. (1896a): Fauna of British India, Moths, *4*: 1-594.

——— (1896b): On the classification of three sub-families of moths of family Pyralidae, the Epipaschiinae, Endotrichinae and Pyralinae. *Trans. Ent. Soc. London*, pp. 451-550.

——— (1916): Descriptions of new Pyralidae of subfamilies Epipaschiinae, Chrysauginae, Endotrichinae and Pyralinae (Lepidoptera). *Ann. Mag. Nat. Hist. London, 18*(8): 126-160, 349-373.

——— (1917): Descriptions of new Pyralidae of subfamilies Epipaschiinae, Chrysauginae, Endotrichinae and Pyralinae (Lepidoptera). *Ann. Mag. Nat. Hist. London, 19*: 65-100.

KLOTS, A. B. (1970): Lepidoptera, in "Taxonomist's glossary of Genitalia in Insects" (ed. S. L. Tuxen), 2nd ed. Munksgaard, Copenhagen, pp. 115-130.

ROSE, H. S. AND PAJNI, H. R. (1978): Further comments on the genus *Tamraca* Moore with the description of a new species from Chandigarh (Lepidoptera: Pyralidae). *J. Bombay nat. Hist Soc., 75* (1): 170-173.

DESCRIPTION OF A NEW SPECIES AND A KEY TO INDIAN SPECIES OF BELOSTOMATIDAE[1]

P. VENKATESAN AND T. K. RAGHUNATHA RAO[2]

(*With seven text-figures*)

Lauck and Menke (1961) showed that *Sphaerodema* was synonymous with Genus *Diplonychus* Laporte of sub-family Belostomatinae. Earlier workers in India, while recording and studying the biology of the species of this genus, had included them under *Sphaerodema* Laporte, overlooking *Diplonychus* (Presswala & George 1936, Rao 1962, Indira 1963, Madhavan 1973). Distant (1906) differentiated *S. annulatum* (Fabricius) from the other two recorded Indian species of this genus on the basis of the nature and the size of the hemelytra and the measurement of the head width between the eyes. He differentiated *S. molestum* Dufour from *S. rusticum* Fabricius on the basis of the size of the claw in the front tarsus. Menke (1960 & 1961) stressed the importance of the structure and terminology of male genitalia and gave a more critical analysis of other characters used to distinguish the taxa of this sub-family. Hence, it is felt worthwhile to include the characters of the genitalia in the present investigation while describing a new species of the genus *Diplonychus*, collected from Chetpet pond, Madras, India and forming a key to the Indian species of *Diplonychus*.

KEY TO THE INDIAN SPECIES OF *Diplonychus* Laporte

1. Total body length less than 20 mm; body narrow and tapering; greatest expanse of hemelytra together shorter than the total body length. .. 2

   Total body length more than 20 mm; body very broad; greatest expanse of hemelytra together equal to the total body length. .. *D. annulatum* (Fabricius)

2. Anterior claws shorter than the width of tarsus. .. 3

   Anterior claws longer than the width of tarsus. .. *D. molestus* (Dufour)

3. Head length shorter than the width between the eyes; the posterolateral margin of the respiratory strap of male without the setal tufts or spikes; air straps meeting at the tip of aedeagus. .. *D. rusticus* (Fabricius)

   Head length more than the width between the eyes; the posterolateral margin of the respiratory strap of male with a cluster of setal tufts or spikes; air straps not meeting at the tip of aedeagus. .. *D. indicus* sp. nov.

Diplonychus indicus sp. nov.

(Figs. 1 to 7)

Diagnosis:

Small and elongated bug measuring 13.5 mm to 16.5 mm long, greatest width being 9.6 to 10.1 mm; ochraceous or ochraceous brown in colour; the lateral and basal margins of pronotum and embolium always paler than the meso—and metathoracic segments (Fig. 1); legs and ventral part of body concolorous; head $1\frac{1}{2}$ times longer than the width between the eyes; anteoculus moderately developed, shorter than the interoculus; eyes slightly convex; interoculus half as wide as the eye; eyes obliquely triangular, strongly flattened

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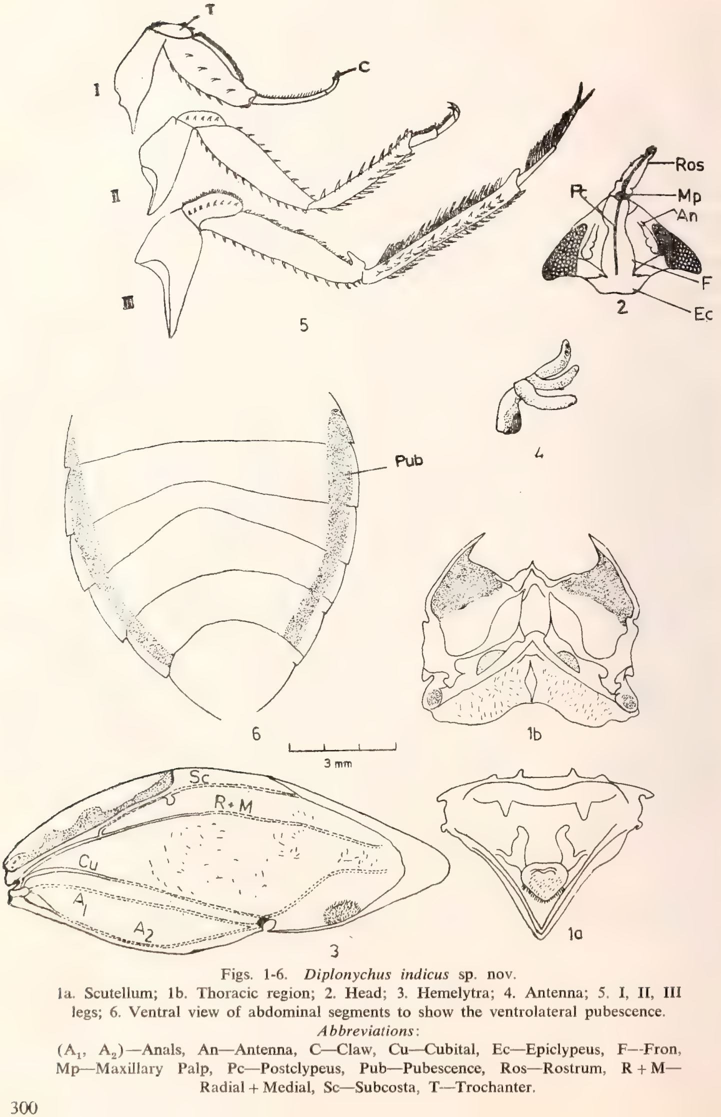
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Figs. 1-6. *Diplonychus indicus* sp. nov.

1a. Scutellum; 1b. Thoracic region; 2. Head; 3. Hemelytra; 4. Antenna; 5. I, II, III legs; 6. Ventral view of abdominal segments to show the ventrolateral pubescence.

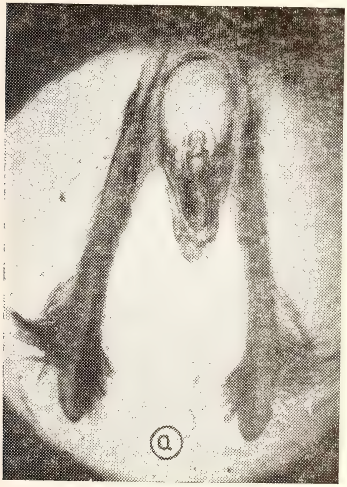
Abbreviations:

(A_1, A_2)—Anals, An—Antenna, C—Claw, Cu—Cubital, Ec—Epiclypeus, F—Fron, Mp—Maxillary Palp, Pc—Postclypeus, Pub—Pubescence, Ros—Rostrum, R + M—Radial + Medial, Sc—Subcosta, T—Trochanter.

dorsally and $1\frac{1}{2}$ times longer than wide (Fig. 2); external margin of eye often straight and continuous with the pronotum; bulgings present on the margin of anteoculus; posterolateral angle of anteoculus variable; claws and embolium of hemelytra paler than meso- and metathoracic segments but not smooth (Fig. 3) and punctured with setigerous holes; membrane of the hemelytra with a patch of minute chitinous hairs at the bottom; rostrum long and conical; segment I of rostrum 2 times longer than segment II (Fig. 2); antenna hidden, four segmented and located near the eyes with segments II and III bearing long curved finger-like projection dorsally; IV segment with slightly bulbous projection than that of II and III (Fig. 4); pronotum with lateral margin nearly straight; anterior margin of pronotum more than half time as wide as the posterior margin.

Ventral laterotergites of abdominal segments III to VII with a narrow, sinuate, central band of pubescence, attaining the external margin at posterolateral angles at the region of III segment only (Fig. 6); abdominal sternites shiny with short spinules.

Legs shiny but often covered with minute spinules; front femur strongly dilated, bearing two grooves for the reception of tibia; front tibia and tarsus usually bearing rows of large setigerous punctures; front tarsus two-segmented, terminated by two small and equal claws that are shorter than the width of the tarsal segment; segments II and III of the tarsus



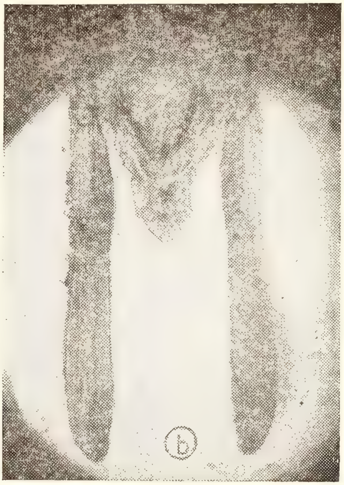


Fig. 7a. Genitalia of male *D. indicus* sp. nov.
Fig. 7b. Genitalia of female *D. indicus* sp. nov.

being fused; segment I of the tarsus shorter than segment II, the division being visible on the ventral side; two spinules project between the claws of the mesothoracic and metathoracic legs (Fig. 5).

The phallus composed of the IX abdominal segment, articulating within the genital capsule as on a U shaped sclerotic basal plate; arising from sides of the genital capsule at the articulations of the basal plate are the parameres, triangular in shape with a feather of setose hairs; a ligamentous lamina ventralis being attached at the base of the basal plate which articulated posteriorly with a rather bulbous sclerotized caudal extension—the ventral diverticulum; the basal half of the phallus surrounded dorsally and internally by rather heavily sclerotized plate—phallobase; a hollow sclerotized tubular aedeagus arises within the phallobase, which extends dorsal to the ventral diverticulum; the VIII abdominal segment being closely associated with the genital capsule, possesses the long air or respiratory straps; air straps not bifurcate and their arms not meeting at the tip of the aedeagus (Fig. 7).

In the male, the lateral margins of the air straps bearing a cluster of setae or setal tufts to form together as a spike extending downwards and being visible to the naked eye; besides the inner margin bearing another cluster of the same nature distolaterally but half as long as the cluster in the outer margin; arising in the phallobase a hollow sclerotized tubular aedeagus, which extends dorsally to the ventral diverticulum (Fig. 7a).

In the female, the air straps not possessing any long setae; female genital plate bearing one tuft of setae on the lateral margins apically (Fig. 7b).

Material studied:

Holotype ♂ collected from Chetpet pond, Madras, India on 6-2-1977.

Allotype ♀ and paratype 5 nymphs collected from the same locality.

The type series is deposited in the Museum of Loyola College, Madras, India.

Measurements:

Holotype and Allotype in mm. (Allotype measurements given in paranthesis). Total body length—14.65 (16.46); greatest width—9.6 to 10.1; anteoculus—1.78 (1.78); interoculus—2.12 (2.12); rostrum—2.78 (2.68); hemelytra—11.42 (11.52); anterior margin of pronotum—4.9 (5.2); posterior margin of pronotum—6.92 (6.92); head length—2.54 (2.30); thorax length—6.24 (6.19); abdominal length—7.87 (7.97); I leg- femur 2.88 (2.88); tibia 2.02 (1.92); tarsus 0.48 (0.48); claw 0.095 (0.095); II leg—femur 5.8 (4.8); tibia 5.56 (5.13); tarsus 2.73 (2.63); claw 0.58 (0.46); III leg—femur 4.08 (3.74); tibia 3.64 (3.46); tarsus 1.54 (1.78); claw 0.48 (0.38).

Remarks:

Diplonychus indicus sp. nov. is closely related to *D. rusticus* (Fabr.) in having hemelytra shorter than the total body length, anterior claws short and the presence of tuft of setae on the lateral sides of the basal plate in the female genitalia. It differs from *D. rusticus* in head length being more than the width between the eyes, cluster of setae forming the spike being present on the posterolateral margins of the respiratory straps, air straps not meeting at the tip of aedeagus, the pubescence of ventrolateral tergites from III to VII reaching the external margin on the segment III only and the membrane of the hemelytra with a patch of spinules at the bottom.

ACKNOWLEDGEMENTS

We are grateful to Dr. Margaret Parsons, Minnesota, U.S.A. for her valuable suggestions. We thank Rev. Fr. Kuriakose, S.J., Principal for providing facilities and extending constant encouragement.

REFERENCES

DISTANT, W. L. (1906): The Fauna of British India, Rhynchota, Vol. III (Heteroptera—Homoptera). Taylor and Francis, London, 35-37.

INDIRA, T. (1963): Biochemical and Cytochemical studies during development and ovarian growth in *Sphaerodema molestum* Duf. Ph.D. Thesis, Annamalai University.

LAUCK, D. R. & MENKE, A. S. (1961): The higher classification of the Belostomatidae (Hemiptera). *Ann. Ento. Soc. Amer., 56*: 644-657.

MADHAVAN, M. M. (1973): Structure and function of the hydropyle of the egg of the bug *Sphaerodema molestum. J. Ins. Physiol., 20*: 1341-1349.

MENKE, A. S. (1960): A review of the genus *Lethocercus* (Hemiptera: Belostomatidae) in the Eastern Hemisphere with the description of a new species from Australia. *Aus. J. Zool., 8*: 285-288.

———— (1961): A taxonomic study of the genus *Abedus* Stal (Hemiptera: Belostomatidae). *Univ. California Publ. Ento., 16* (8): 393-440.

PRESSWALA, M. J. & GEORGE, C. J. (1936): Morphology of *Sphaerodema rusticum* Fabr. *J. Univ. Bombay, 4*: 29-65.

RAO, T. K. R. (1962): On the biology of *Ranatra elongata* Fabr. (Heteroptera: Nepidae) and *Sphaerodema annulatum* Fabr. (Heteroptera: Belostomatidae). *Proc. Roy. Ento. soc. Lond., 37*: 61-64.

ACONOGONON KUTTIENSE (POLYGONACEAE)—A NEW SPECIES FROM N. W. HIMALAYA[1]

G. G. MAITI, R. M. DUTTA[2] & C. R. BABU[3]

(*With five text-figures*)

Aconogonon kuttiense sp. nov. (Figs. 1-5)

Arcte affinis *A. tortuosum* (D. Don) Hara, sed foliis anguste elliptico-lanceolatis subtus tomento denso albo-lanato indutis, inflorescentia plus minusve laxe racemosa axillaris brevis, perianthio majore differt; a *A. sericeum* (Pallas) Hara, inflorescentia racemosa, perianthio glabro, foliis minoribus discrepat.

Suffrutex erectus, nanus 15-45 cm altus; radix perennis, crassa. *Caulis* repetite dichotome ramosus, subteretis vel teretis, costatus, rubro-brunneus, indumento fere longe erectopatento vel adpresse brevi-setoso vestitus. *Folia* subsessilis, 1—3.5 × 0.3—1 cm, anguste elliptico-lanceolata vel oblonga, ad basim angusta et acuta, margine fortiter revoluta, ad apicem obtuso-acuta, fere rubro-brunnea, supra tenuiter adpresse pilosa, infra dense albo-lanata, supra nervis depressis, infra nervis principalibus conspicuis. *Ochreae* tubulares, basin versus irregulariter laceratae, dein deciduae, membranaceae, distincte nervosae dense adpresse longe setosae, setis ± 1.5 cm longis vestitae. *Flores* racemosi, raro brevipaniculati, 1.5—3 cm longi, terminales vel axillares, albotomentosi; pedunculi 3—8 (—10) mm longi; Bracteae membranaceae, primo tubulares dein irregulariter laceratae, adpresse longe albo-tomentosae 2.5—3 mm longae; pedicelli tenues, anguste marginati, glabri, 1—1.5 mm longi. *Perianthium* rubrum, campanulatum, 3.5—4 mm longum, ad trientem fissum undique glabrum, segmentis 5, raro 6, oblongis, obtusis ± 3 mm longis. *Stamina* 8; filamentis linearibus, 1—1.2 mm longis; antherae minutae, late oblongae, 0.3—0.4 mm longae. *Ovarium* par-

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[1] Accepted July 1980.

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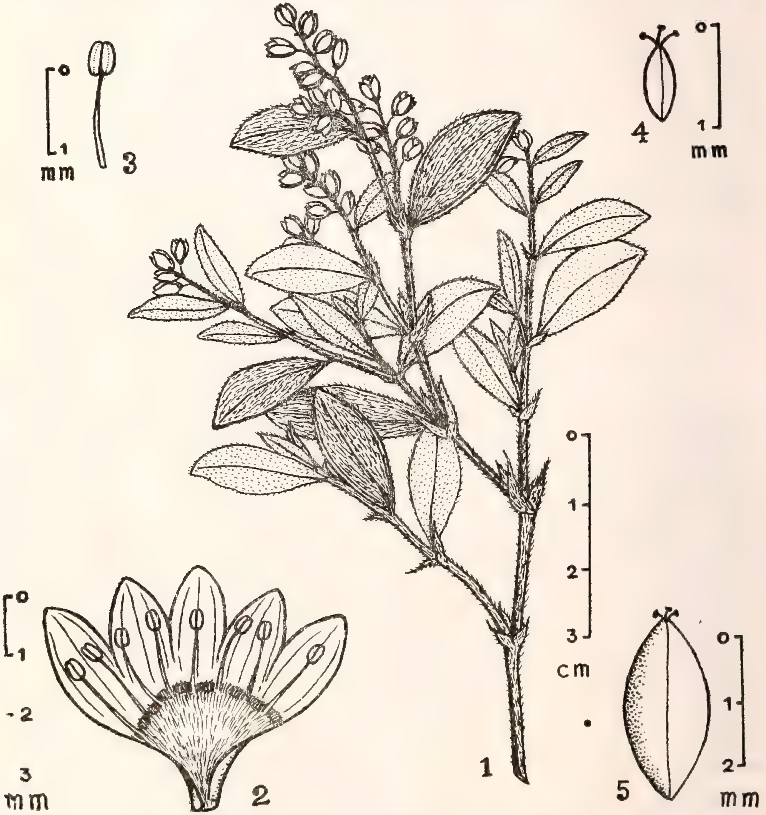
vum, 3-quetrum, 0.7—0.8 (1) mm longum; styli 3, breves, 0.1—0.2 mm longi, apice capitato-stigmatosi. *Nux* rubro-brunnea, ellipsoidea, triquetra acute marginata, perianthio aequilonga, ± 4 mm longa.

Holotypus (*R. M. Dutta* 277A) et isotypi (*R. M. Dutta* 277B) lecti die Sept. 22, 1968, in loco Kutti, in provincia Uttar Pradesh,



Figs. 1-5. *Aconogonon kuttiense* sp. nov.
1. Habit; 2. Flower opened out with ovary removed; 3. Stamen; 4. Gynoecium; 5. Fruit.

India; Holotypus et isotypi positi CAL. Paratypus: Kumaon, Kutti Valley, 14-15000 ft., 31-7-1886, J. F. *Duthie* 5929 (CAL) and Kutti Valley, way to Samzurkchan Glacier, 3 km. from Kutti village, C. 4000 m., 24-10-1976, *G. G. Maiti* 790 (CAL).

Closely allied to *A. tortuosum* (D. Don) Hara but is easily recognizable by densely white-lanate or woolly lower surface of the leaves, narrowly elliptic-lanceolate leaves with a narrowed base, axillary, short, more or less lax racemes and larger perianth. *A. sericeum* (Pallas) Hara—a Siberian species, is also very similar to this in its hairiness and shape of leaves, but *A. sericeum* (Pallas) Hara differs in having axillary flower-clusters, hairy perianth and larger leaves. Whereas *A. kuttiense* is characterised by flowers being in racemes, glabrous perianth and smaller leaves.

The specific epithet is derived from the name of the locality from where it was collected thrice, by Duthie during 1886, then by Dutta 1968, and by Maiti 1976.

ACKNOWLEDGEMENTS

We are grateful to Dr. M. P. Nayar, Deputy Director, Central National Herbarium, Howrah, for Latin translation and helpful suggestions. Thanks are also due to the Council of Himalayan Exploration and Research, Calcutta, for providing financial assistance and opportunity to join the "Kutti Valley Expedition—1968 and 1976".

A NEW SPECIES OF *JASMINUM* (OLEACEAE) FROM INDIA[1]

A. K. SINHA, G. G. MAITI AND G. S. GIRI[2]

(With a text-figure)

Jasminum simonsii sp. nov.

J. dispermo (*J. dispermum* Wall.) affinis, a qua differt plantis glabris, foliis simplicibus, 5-nervibus, combinate venosis, cymis laxis eramosis, pedunculis longis gracilibus, calycis dentibus acuminatis, et tubo corollae brevi.

Frutex parvus gracilis, glaber, partibus junioribus pruinosis. Folia simplicia, ovata ad ovato-lanceolata, 7-10 × 3.5-4 cm, apice acuminata basi cordata ad rotundata, integra, glabra, membranacea, infra secus nervos majores puberula, 5 nervia, combinate venosa, petioli 10-13 mm longi, glabri ad pruinosi, penitus canaliculati. Inflorescentia cymosa axillaris, eramosa, 2-5 flora, pedunculi 2-3 cm, pedicelli gracili, 1-2 cm longi, glabri vel raro pruinosi. Flores bracteati, bracteae subulatae angulares, 2-3 mm × 1 mm. Calyx 5-lobus, cupularis, dentes acuminati, glabri. Corolla 5-loba, tubularis, tubus 10 mm longus, lobi ovato-lanceolati, 6 × 5 mm, acuti, glabri. Stamina 2, in tubo inclusa, fila 7 mm, antherae 5 mm, oblongae, 2-cellulares. Ovarium ovoideum, 2 mm diametro, stylus 12 mm, filiformis, glaber; stigma lineari-oblongum, bifidum. Fructi maturi seminaque non visa.

Holotypus lectus a *Simons* sine numero, sine loco, et positus in herbario indico nationali (CAL) sub numero accessionis 285972.

Jasminum simonsii sp. nov.

Small slender shrub, glabrous to pruinose in

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[1] Accepted July 1980.

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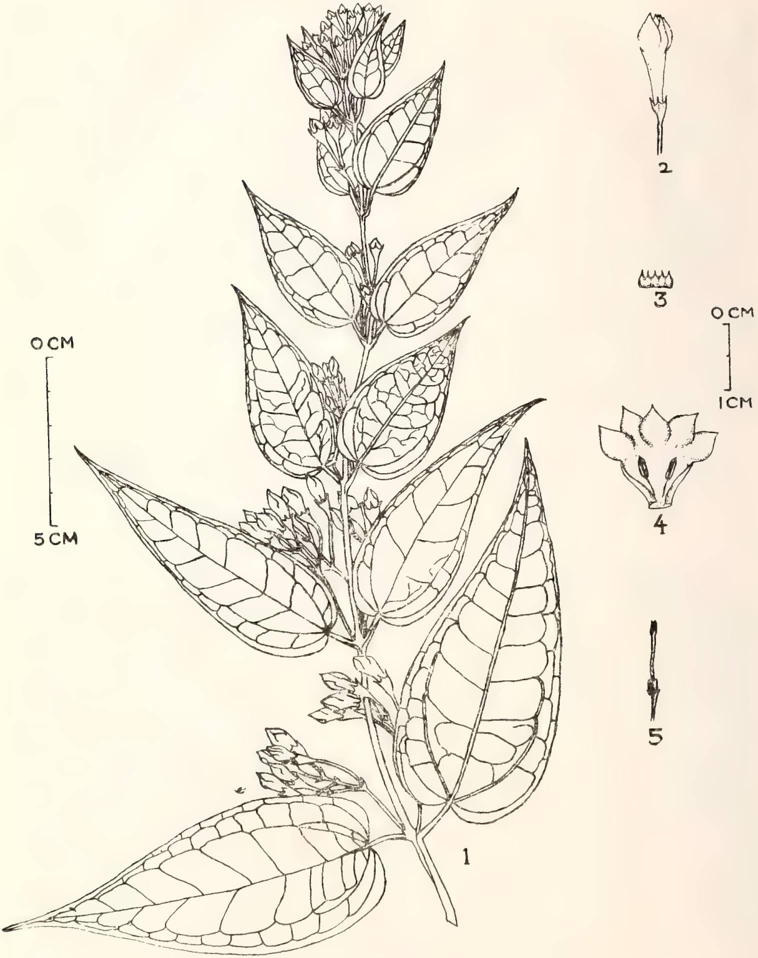
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Figs. 1-5. *Jasminum simonsii* sp. nov.
1. A portion of the twig; 2. Flower; 3. Calyx split open; 4. Corolla split open with two stamens; 5. Gynoecium.

younger parts. Leaves simple, ovate to ovate-lanceolate, 7-10 cm × 3.5-4 cm, apex acuminate, base cordate to rounded, entire, glabrous, membranous, puberulous along the major nerves below, 5-nerved, convergent with successive marginal loops. Petiole 10-13 mm, long, glabrous to pruinose, deeply channelled. Inflorescence axillary cyme, unbranched, 2-5 flowered. Peduncle 2-3 cm. Pedicels slender, 1-2 cm long, glabrous or rarely pruinose, Flowers bracteate, bracts subulate, angular, 2-3 mm × 1 mm. Calyx 5-lobed, cupular, teeth acuminate, glabrous. Corolla 5-lobed, tubular, tube 10 mm long, lobes ovate-lanceolate, 6 × 5 mm, acute, glabrous. Stamens 2, included within the tube, filaments 7 mm, anthers 5 mm, oblong, 2-celled. Ovary ovoid, 2 mm diam.; style 12 mm, filiform, glabrous; stigma linear-oblong, bifid. Mature fruits and seeds not seen.

Holotype: Without any precise locality, *Simons* s.n. (CAL) [*Jasminum attenuatum* Roxb. ex DC.—Det. by C.E.C. Fischer, dated 12-8-1936, Acc. No. 285972].

Isotype: Without any precise locality, *Simons* s.n. (CAL) [*Jasminum attenuatum* Roxb. ex DC.-Det. by C.E.C. Fischer, dated 12-8-1936, Acc. No. 285972A].

The specific epithet was chosen based on Mr. Charles J. Simons, who was a pioneer collector in the regions of Khasia hills and Mikir hills.

Jasminum simonsii sp. nov. differs from *J. dispermum* Wall. in having glabrous plant body, simple leaves, 5-nerved, lateral nerves united before they reach the margin, unbranched lax cyme with long slender peduncles, dentate acuminate calyx lobes and short corolla tube. It is related to *J. stenopetalum* Lindl, but can be easily differentiated by the acuminate leaves, 5-nerved, glabrous, except the nerves beneath, larger peduncles and pedicels, smaller angular bracts, shorter calyx teeth and 5-shorter ovate corolla lobes.

ACKNOWLEDGEMENT

We wish to thank Dr. N. C. Majumdar for Latin translation and valuable suggestions.

A NEW SPECIES OF *EUNOTIA*[1]

P. T. SARODE AND N. D. KAMAT[2]

(*With two text-figures*)

During studies on the freshwater diatoms of the Vidarbh region of Maharashtra State we came across a species of *Eunotia* which is different in many respects from all known species of *Eunotia* and hence described here as new.

Eunotia vidarbhensis sp. nov. (Figs. 1-2)

Frustula solitariae, in aspectu zonali asymmertice, linearis; valvae 34.5—36.7 μ longae, 6—6.5 μ latae, aliquantum arcuatae, tenuiter curvatis ac latere ventrali paulum inflatae ad anum apice; apicibus late rotundatis; nodulae polares retractis, satis magnae ac raphe terminalibus distinctis; striae 14—16 in 10 μ, plus minus equidistante evolutae sed proxime

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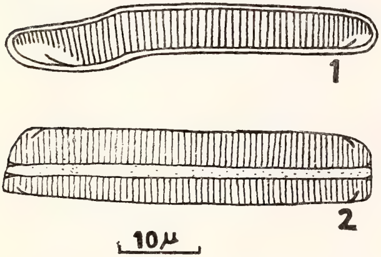
[1] Accepted May 1980.

[2] Botany Department, Institute of Science, Aurangabad.

positae ad apicem, crassae.

In palude, Nagpur (20-1-78).

Typus lectus ab autores et positus in collectione sub numero V 540.



Figs. 1-2. *Eunotia vidarbhensis* sp. nov. 1. Valve view; 2. Girdle view.

Frustules solitary, asymmetrical, linear in girdle view; valves 34.5—36.7 μ long, 6—6.5 μ broad, scarcely arcuate, slightly inflated on the ventral side at one end; ends broadly rounded; polar nodules retracted, fairly large with termination of raphe distinct; striae 14—16 in 10 μ, more or less uniformly set but somewhat closer towards the ends, coarse.

In a pond, Nagpur (20-1-78).

Type collected by the authors and kept in the collections No. V 540.

The new species is close to *Eunotia major* (W. Sm.) Rabh. f. *ventricosa* A. Cl. (Cleve-Euler 1953, 119, f. 456d, e) and *Eunotia asymmetrica* Chol. (Cholnoky 1954, 209, f. 21) in some respects but differs from both of them in shape and dimensions. In addition it differs from the former in not having pseudoraphe and from the latter in having denser and coarse striations.

ACKNOWLEDGEMENT

Grateful thanks are due to Prof. Dr. L. A. Whitford, North Carolina for help in Latin translation and identification of the specimen.

REFERENCES

CHOLNOKY, B. J. (1954): Diatomeen aus Sud-Rhodosien. *Port. Acta. Biol.* (B) *4* (3-4): 197-228.

CLEVE-EULER, A. (1953): Die Diatomeen von Schweden und Finnland-II. *K. Svenska Vetens Akad. Handl. Fjurde* ser. *4*: 1-158.

OBITUARY

D. E. REUBEN

(1893-1980)

It is with deep regret that we record the death of Mr. D. E. Reuben on 24th March 1980, after a long and painful illness borne with patience and fortitude.

David Ezra Reuben was born at Hassan, Mysore, on 3rd September 1893 and did his schooling at St. Joseph's, Bangalore, and Bishop's High School in Poona. He then took his B.A. in Mathematics at the Deccan College, Poona, followed by a first class in Mathematics at St. John's College, Cambridge. While at Poona, he participated in cricket, rowing and rifle-shooting, and then secured tennis colours at Cambridge.

Standing first in his batch for the I.C.S. Examination in 1917, he served as a Sub-Divisional Officer in Bihar and Orissa, and then as an additional Magistrate. Having opted for the judiciary, he took the Bar Examination, reached the High Court in 1943, and retired as Chief Justice of Bihar in 1953. After retirement, he settled down in Bombay, and served for three years as a member of the Labour Appellate Tribunal.

During the years of his service, Bihar and Orissa were still wild areas and he shot his fair share of deer, antelope, and the larger carnivores. He joined the BNHS in 1924. In Bombay, he served on the Executive Committee of the Bombay Natural History Society from 1954-1975 and though his name appears as editor of the Society's Journal only for two years, he vetted the proofs and read the minutes and other papers of the Committee with meticulous care and the queries and notings marked 'D.E.R.' always received the closest attention and respect. The 2nd edition of Prater's BOOK OF INDIAN ANIMALS owed much to him. The present writer was particularly fortunate in receiving similar assistance which permitted him to prepare, often in a hurry, the several papers[1] published by him in the *Journal* over recent years and as a small token of which an Andaman bird has been named *Oriolus xanthornus reubeni*.

Such unassuming and valuable assistance is seldom available and both the Society and individual members have suffered an irreplaceable loss.

HUMAYUN ABDULALI

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[1] List of papers & Notes.

On the occurrence of the Clucking Teal (*Nettion formosum*) in the Monghyr District *45*: 609.

A jumping snake *53*: 477.

The Abominable Snowman *54*: 762.

The Indian Mongoose in Jamaica *54*: 941.

Gazelle in North Africa *55*: 343.

Occurrence of the Blue Mormon (*Papilio polymnestor* Cramer) in Bombay *57*: 231.

Migrational flights of the common Indian Crow butterfly [*Euploea core* (Cramer)] *57*: 673.

Nocturnal 'Predator' of fruit of Yellow Oleander (*Thevetia neriifolia*) *58*: 808.

Occurrence of the Blue Mormon (*Papilio polymnestor* Cramer) in Bombay *58*: 816.

Intelligent behaviour by the Mason Wasp (*Eumenes petiolata* Fabr.) *60*: 283.

Persistent vitality in Bee-hole Borer Moth *Duomitus leuconotus* Wlk. *65*: 801.

Crabs summering in lakeside hotel *75*: 516.

REVIEWS

1. THE FAUNA OF INDIA, SPIDERS. Araneae, Vol. I. Part 1, Thomisidae (crab-spiders). By B. K. Tikader, iv + 1-247 pp., 2 pls. Part 2. Lycosidae (wolf spiders), By B. K. Tikader and M. S. Malhotra, 249-446 pp., 2 pls, Issued by the Zoological Survey of India, Calcutta, 1980, Price India: Rs. 100/- Foreign: £10/- or $20.00.

Spiders, though ubiquitous, have remained a neglected group, and in the only consolidated volume, on the Arachnida, published 80 years ago, in the FAUNA OF BRITISH INDIA series (now called the FAUNA OF INDIA), Pocock (1900) listed only some 200 species, and the family Thomisidae (which forms half of the present volume) was not even represented. In the last 20 years, mainly through the work of Dr. Tikader, an enormous amount of information on Indian Spiders has been gathered together, and the present is the first of a series of projected volumes on Indian spiders. The volume is divided into two halves. The first half deals with the family Thomisidae (by Tikader) and the second half with the Lycosidae (by Tikader and Malhotra).

The volume begins with a short but clear and well illustrated account of the taxonomic characters of spiders, followed by a key to the 44 families of Indian spiders. Then follows the descriptions of various genera and species. The taxonomic accounts are clear, precise and extremely well illustrated by the taxonomically important body-parts, especially the cephalothorax and the epigyne. In all cases, excellent identification keys for genera and species are provided. There is a select bibliography and an alphabetical index of species and genera. The Thomisidae includes 25 genera and 115 species and the Lycosidae 9 genera and 81 species.

Considering that there are still 42 families to cover, the spider series may be expected to run to several volumes, and we sincerely hope that Dr. Tikader, who is to be warmly congratulated upon this fine volume, will be able to complete the volumes within a reasonable period of time, perhaps during the next five or six years.

A remarkable fact that emerges from a perusal of the volume under review is that so many species are described from single specimens. This emphasises the need for intensive collections, by both professional zoologists and the non-professionals, in order that the lacunae can be satisfactorily filled.

The printing, which is on art paper, and the binding are very good, and we can only hope that subsequent volumes in the *Fauna* series will be able to maintain this high standard.

M. L. ROONWAL

2. COLLIN'S HANDGUIDE TO THE BIRDS OF THE INDIAN SUB-CONTINENT, INCLUDING INDIA, PAKISTAN, BANGLADESH, SRI LANKA & NEPAL. Written and illustrated by Martin W. Woodcock. Designed by Hermann Heinzel. pp. 176 (19 × 11.5 cm) with coloured and monochrome illustrations. Distributed by Rupa & Co. Price £4 (Rs. 94), Hardback; £3 (Rs. 66), paper back.

This is the first real attempt at a field guide to the birds of the Indian Sub-Continent on the lines established by Peterson for American birds just about 50 years ago. 272 species are illustrated in colour, followed by 273 sketches in black and white.

A quick look-over has been very enjoyable but attention may be drawn to a few points which may be rectified in the next edition.

The first bird, the Dabchick, is referred to as *Tachybaptus ruficollis*. This generic name is probably being used for the first time in Indian literature and raised the fear that there was to be a plethora of name changes, but this proved unwarranted. The sequence is not the same as in INDIAN HANDBOOK. The pictures are on the whole excellent, though some of the colours do appear a bit too vivid, e.g. the Red Junglefowl (p. 38) and the Courser (p. 59). The stripe down the front of the Purple Sunbird (p. 108) shows very blue.

On page 10, reference is twice made to a 1000 km contour which is presumably a slip for the land over 1000 metres shown on the map opposite.

In the good old days, Great Indian Bustard were sometimes seen in small parties of 5 to 8 but these were scattered over a mile or more and one wonders if ten would be seen together on the ground as illustrated (pp. 48-49). Again while several snipe may rise togather, it is unlikely that one would see three of them together on the ground (p. 57). The Fantail Snipe in flight is too heavily marked on the underparts, and lacks the white trailing edge to the wing (really secondaries only), which character distinguishes it from the Pintail. The popular name of *Buceros bicornis* the Great Indian Hornbill has been changed to the Great Pied Hornbill. As two other pied hornbills already exist it would perhaps be better to drop the term "pied" and continue to refer to the old name. The male of the Common Iora on page 89 would perhaps be more distincitive with a black head, and the colour of the male Rosefinch on page 111 is the only one which I would call really misleading.

With this example before us, we may hope that we will in due course see a similar field guide which covers *all* the Indian species and also perhaps the subspecies which are sufficiently distinct. *Thereiceryx zeylanica* on page 76 has a streaked breast, and the Bombayman suspects an error, for the nominate race in western and southern India has a plain breast. The picture represents *caniceps*, the northern race of *zeylanica*, (which is found as far south as Chikalda, Berar) but suggests another species *M. viridis*. The House Crow of the nominate race on p. 7 shows no pale collar round the neck, while birds around Bombay, accepted as *C. splendens splendens* do. These are only subspecific differences and when one considers that only 543 of some 1250 species (220 species and subspecies) are illustrated, there is still a long way to go.

The last paragraph in the book is a handsome tribute to the BNHS journal.

In the Introduction (p. 15) the author says that half the battle in bird identification is in knowing what to expect in a given area or season. We hope he will soon produce another guide which covers all the species likely to be seen including Martin and Woodcock.

It is indeed a fine effort and Mr. Martin Woodcock who had illustrated A FIELD GUIDE TO THE BIRDS OF SOUTH EAST ASIA (1975) is to be sincerly congratulated.

HUMAYUN ABDULALI

MISCELLANEOUS NOTES

FOOD HABITS OF THE INDIAN WILD DOG (*CUON ALPINUS*): A PRELIMINARY ANALYSIS

From October through December of 1975, one hundred and fifty (150) droppings of wild dogs (*Cuon alpinus*) were collected from within an area of twenty four (24) square miles in and around the eastern entrance of the Mudumalai Wildlife Sanctuary in Tamil Nadu. The study area was bounded by the Kalhatty slope to the east, the village of Masinigudi to the west, Anaikatti to the north, and Bokapur to the south.

This region of the Nilgiris lies at an altitude of between 3000 and 3500 feet and is characterized by low scrub jungle, interspersed with stands of bamboo surrounding the larger waterways. Cultivation is common and occurs at fairly regular intervals throughout the study area. At the time of collection, the north-east monsoon was well under way, providing moisture necessary for the rapid growth of lush vegetation. Consequently, the animal life, large and small was abundant.

As the wild dog typically whelps from November through February (Cohen 1977), only yearling and adult dogs are assumed to have contributed to our sample.

Identification of fecal content was made using hair samples, bone fragments, vegetation, and insect parts found in each bolus. For this preliminary analysis, unknown hair samples were compared by gross visual inspection with similar samples collected from known species at the Bombay Natural History Society. A more detailed hair follicle analysis, based on microscopic techniques will be reported elsewhere. Bone fragments were identified by A.J.T. Johnsingh and K. Paramanantham of the Ayya Nadar Janaki Ammal College in Sivakasi, Tamil Nadu. Assistance in the identification of vegetational types was kindly given by Dr. M. Joseph, Regional Botanist of the Botanical Survey of India at Coimbatore, Tamil Nadu.

The food items represented in the droppings, the number of times each item occurred, and their frequency percentage in the sample are shown in Table 1.

TABLE 1

DIET OF THE INDIAN WILD DOG (*Cuon alpinus*) AS DETERMINED BY FECAL ANALYSIS OF 151 DROPPINGS

Item	Times occurring	Frequency percentage
Spotted Deer (*Axis axis*)	62	41
Sambar (*Cervus unicolor*)	10	7
Wild Pig (*Sus scrofa*)	3	2
Mouse Deer (*Tragulus meminna*)	1	0.7
Blacknaped Hare (*Lepus nigricollis*)	53	35
Rodentia	17	11
Unidentified Mammal	11	7
Domestic livestock	1	0.7
Insecta	9	6
Fruits	2	1
Grasses & Vegetation	71	47

A similar collection of 138 droppings was made by Dr. Michael Fox and A. J. T. Johnsingh in December through February, 1974 and will be cited in the following discussion. These results are summarized in Table 2.

relative food abundance. It was reported to these investigators by the Forest Ranger at Theppakadu that the estimated chital population in the Sanctuary in 1975 was approximately 1750 animals (by pellet count), while the sambar population numbered only about 200. These facts and the additional fact that Sambar are relatively solitary in their habits as opposed to the chital, who tend to congregate in herds of up to 250 animals in the evening, before breaking up into smaller foraging groups during the daylight hours, may help to explain our observed results. Periods of hunting activity in the wild dog correlate well with the observed increase in the sizes of chital herds in early evening and early morning hours.

TABLE 2

DIET OF THE INDIAN WILD DOG (*Cuon alpinus*) AS DETERMINED BY FECAL ANALYSIS OF 138 DROPPINGS

Item	Times occurring in adult faeces	Times occurring in pup faeces	Total freq. %
Spotted Deer (*Axis axis*)	102	5	78
Sambar (*Cervus unicolor*)	13	0	9
Wild Pig (*Sus scrofa*)	1	0	0.7
Small Mammals (lagomorphs, rodents)	12	2	10
Domestic Livestock	3	0	2

Iseilema prostratum grass common in faeces

Segments of tapeworm, *Taenis hydatigena* frequent in scats.

DISCUSSION

Mammals :

Spotted deer (*Axis axis*) exceeded all other items in the diet, except grasses. They were six per cent (6%) more frequent in the droppings than hare remains. That these animals are the chief staple in the diet is thus reaffirmed. In those scats able to be identified as such, chital fawns outnumbered adults as prey by almost three-to-one (3:1). Sambar comprised a relatively small part of the diet (7%). Fox and Johnsingh (1975) also found spotted deer remains in seventy-eight per cent (78%) of the samples they collected from the same area in January and February of 1974, compared to only nine per cent (9%) sambar. There may be several explanations for this observed preference of chital in the diet. There is a great size difference between sambar and chital and, given the fact that the dogs usually hunt in groups of three to five individuals, a full-grown sambar may present too much of a risk to the predator, especially in times of

The remains of wild pig, a common inhabitant of the region, occurred in only two per cent (2%) of the sample. Mouse deer (*Tragulus meminna*) for Indian Chevrotain also play a very minor role in the wild dog's diet, comprising only seven-tenths of one per cent (0.7%). This may be expected due to the rarity of this species in the region.

Blacknaped hare ranked next to chital in relative frequency of occurrence (35%). This correlates well with the observed abundance of this species of lagomorph in the study area.

No other lagomorph species occurs in the area of the Mudumalai.

Eleven per cent (11%) of the fecal samples contained members of the class *Rodentia.*

In the present study, hare and rodents comprised forty-six per cent (46%) of the wild dog's diet. Johnsingh and Fox, in 1974 found all small mammals to make up only ten per cent (10%) of the total diet. It must be taken into consideration, however, that while the present collection was made at the end of the monsoon season, the other was made at the height of the dry season. Due to the extreme ground temperatures, lack of cover, scarcity of water, and reduced availability of food, a reduction of small mammal activity and a probable reduction in population sizes of such animals would subsequently result in a reduction in the frequency of these prey items in the dogs' diet.

According to analysis of fecal samples, domestic livestock comprised only seven-tenths of one per cent (0.7%) of the dogs' total diet. This is most interesting in light of the fact that the wild dog is still considered to be a "pest", with bounties awarded for its extermination. M. Krishnan (1972) states that wild dogs rarely take domestic stock as prey. Although this statement is reaffirmed in the present study and from the collection and analysis made by Fox and Johnsingh (op. cit.), who found livestock remains in only two per cent (2%) of their sample. Fox, found, upon asking paddi owners, that nearly seven per cent (7%) of their cattle losses are attributed to wild dogs. It is possible that in times of scarce food supply, the wild dogs turn to domestic stock, which is plentiful in the region, for food. Other possibilities also exist. Among those is the possibility that the actuals kills are not witnessed by the paddi owner, but merely the loss of an animal is automatically attributed to the wild dog. Indeed there seems to be some disparity between observed proportions of cattle in the wild dogs' diet and their reputed effect on livestock numbers in the area. By studying the food habits of the wild dog in relation to that of the leopard, tiger, and pariah (pie) dog (*Canis familiaris*), a recently introduced predator, a true picture of the wild dogs' role in the region's ecology could be gained. The common attitude of the wild dog as a "pest" to be exterminated requires intensive re-examination.

The remaining animal matter found in the feces (7%) were unidentifiable due to the condition of the scats themselves. The age of the dropping (e.g. calcification of contents) and the quantity recovered prevented any definite identification of the hair samples.

Miscellaneous :

Insects appeared in only six per cent (6%) of the droppings. The majority of these were identified as beetles (from elytra and wings). It is not known if these animals were purposefully eaten or perhaps entered the feces after being deposited. Fruit of the *Zizyphus* genus was found in one per cent (1%) of the sample. Although this seasonal fruit seems to serve as a food source for many of the mammalian and avian herbivores of the area, it does not appear to be an important supplement in the diet of the wild dog.

The most frequent item found in the feces of the wild dog was grass and vegetation. Although only two of the one hundred and fifty-one droppings were totally vegetable in content, occurrance in all other cases appeared incidental to the existance of animal matter. The following grasses were identified: *Heteropogon contortus, Cynodon dactylon, Dactyloctenium aegyptium, Cynodon barberi, Aristida hystrix,* and *Eragrostis bifaria.*

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REFERENCES

COHEN, J. A. (1977): A review of the biology of the dhole on Asiatic Wild dog (*Cuon alpinus*). *Anim. Reg. Stnd. 1*: 141-158.

FOX M. W. (1975): In Search of Wildness and Whistling Jungle Dogs. Unpublished.

FOX, MICHAEL & JOHNSINGH, A. J. T. (1975): Hunting and feeding in wild dogs. *J. Bombay nat. Hist. Soc. 72*(2): 321-326.

KRISHNAN, M. (1972): An ecological survey of the large mammals in peninsular India. *J. Bombay nat Hist. Soc. 69*: 26-54.

2. OBSERVATION ON CARNIVOROUS HABIT OF AN IRRAWADDY SQUIRREL, *CALLOSCIURUS PYGERYTHRUS* (GEOFFROY)

During a trip to North Lakhimpur, Assam, in October 1976, an interesting behaviour of the Irrawaddy Squirrel, *Callosciurus pygerythrus* (Geoffroy), was noted.

On October 15th 1976 at about 8.00 hours, I noticed the animal eating the fruit of an Olive tree (*Olea europaea*) in a small orchard (about an acre in area) having a pond and other trees, namely Embelic (*Embelica officinalis*) in fruit, shrubs such as Lemon (*Citrus lemon*) and undergrowth mainly of Pineapple (*Ananas sativus*) and other fruit-bearing herbs, just behind the house where I was camped. The squirrel slipped away when an attempt at closer observation was made. On that very day at about 16.00 hours, the cackling call of a squirrel was heard, but unfortunately, it could not be traced. The following day two mongooses were seen busily digging the earth beside the pond. With a view to catching them, two traps were set in the bushes at about 13.00 hours with intestine of chicken as bait. After about two hours, to my great surprise I found that an Irrawaddy Squirrel, instead of a mongoose, had been trapped. It was still feeding on the bait. The squirrel was allowed to consume the whole of the bait without being disturbed.

According to literature (Prater 1971), *Callosciurus pygerythrus* (Geoffroy) feeds on fruit, leaf-buds and is particularly partial to oranges. In spite of the availability of abundance of fruits on the trees in and around the area the preference for animal food is highly interesting.

ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET,
CALCUTTA 700 016,
December 26, 1978.

SANTANU GHOSH

REFERENCE

PRATER, S. H. (1971): The Book of Indian Animals. ed. 3, Bombay Natural History Society, Bombay.

3. UNUSUAL RAT FEEDING BEHAVIOUR ASSOCIATED WITH CATTLE AFFECTED WITH FOOT AND MOUTH DISEASE

(*With a text-figure*)

An epidemiological investigation aimed at revealing the possible role of rodents in the transmission of foot and mouth disease was conducted in Purulia district of West Bengal. Rats (*Rattus rattus*) and squirrels (*Funambulus pennanti*) were trapped in and around cow sheds which had harboured confirmed cases of foot and mouth disease two months previously. Their blood was collected and the serum was tested as described below.

The study utilized an immuno-diffusion test (Virus Infection Associated antigen) to detect the presence of serum antibodies specific for foot and mouth disease (FMD). Antibodies to the Virus Infection Associated (VIA) antigen cross reacts with all four types of foot and mouth disease (O, A. C and Asia$_1$) found in India (Cowan and Graves 1966) and is diagnostic with just a single test (unlike serum neutralization and compliment fixation tests).

The results of this study demonstrated that no squirrels (10 serum samples) and no rats (47 serum samples) were infected by the FMD virus despite an intimate association with the infected cattle. (Many villagers reported that they had seen rats feeding on the foot lesions of the FMD infected cattle when they would enter the cow shed at night.)

An unexpected result was a definite precipitation line between the unknown rat serum wells and the control bovine antisera wells in twelve out of forty-seven cases (see figure 1). This same phenomena was never observed with any of the squirrel sera.

The precipitin line between the control bovine serum and unknown rat serum depicted in the figure may be explained by various interpretations. It could be due to; a non-specific reaction, the presence of a cross-reacting antibody, a common infective process, or specific antibodies in one serum directed toward serum components of the other. The last explanation seems more plausible for the reasons outlined below.

Rats were seen feeding on the FMD lesions at which time serum substances undoubtedly could have been ingested. It is known that mice given bovine serum orally will develope specific antibodies to certain components (Andre *et al.* 1973). No other species of animal tested (cattle, goats, sheep, chickens or squirrels) demonstrated a similar precipitin line in the VIA test. It is probable that not all rats fed on the FMD lesions or fed intense enough to become sensitized to bovine serum factors.

While the above is admittedly a conjecture, it does provide some possible scientific documentation to the villager's observation of rats feeding on the foot lesion of cattle infected with FMD.

Even though rats are considered "versatile feeders" (Barnett 1975) it is doubtful that this particular feeding behaviour has been reported before. It is unknown how common or extensive this practice is.

ACKNOWLEDGEMENT

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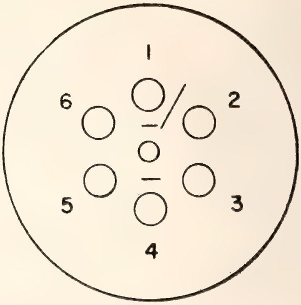

Fig. 1. Agar gel immuno-diffusion VIA antigen test for serum antibodies to foot and mouth disease. The central well contains the VIA antigen. Wells number 1 and 4 contain known reacting control bovine antisera. Wells number 2, 3, 5 and 6 contain four different unknown rat serum samples. The line between the central well and well 1 and 4 is a positive reaction of VIA antigen and its specific antibody. The line between well 1 and 2 may be due to an antigen—antibody complex of unknown origin which occurred in 12 out of 47 rat sera tested.

REFERENCES

ANDRE, C., BAZIN, H. & HEREMANS, J. F. (1973): Influence of repeated administration of antigen by the oral route on specific antibody producing cells in the mouse spleen. *Digestion 9*: 166-175.

BARNETT, S. A. (1975): The Rat. A study in behaviour. University of Chicago Press. Chicago. 318 pp.

COWAN, K. M. & GRAVES, J. H. (1966): A third antigenic component associated with foot and mouth disease infection. *Virology 30*: 528-540.

4. BAIT SHYNESS AND POISON AVERSION IN *BANDICOTA BENGALENSIS* (GRAY) USING RH-787 AS RODENTICIDE

INTRODUCTION

Studies have been made on behavioural aspects of poison aversion and bait shyness in *Rattus rattus* (Barnett *et al.* 1975), *Tatera indica, Meriones hurrianae* (Prakash and Jain 1971) and *Gerbillus gleadowi* (Rana *et al.* 1975). In the present experiments, studies have been made on bait shyness and poison aversion in *Bandicota bengalensis* (Gray) when subjected to sub-lethal dose of RH—787 (N-3-Pyridylmethyl-N-P-Nitrophenylurea)[1]. Acceptability of RH-787 to *B. bengalensis* in laboratory conditions has already been studied (Sood and Dilber 1977).

MATERIAL AND METODS

Ten individuals of *B. bengalensis* were kept segregated in laboratory cages for 15 days to acclimatise them. Each individual was daily provided with sorghum (*Sorghum vulgare*) and millet (*Pennisetum typhoides*) grains. Water was supplied *ad-libitum*. For the first three days, total daily intake (TDI) of each food item was measured. For the subsequent four days, 0.025 per cent of RH-787 (Vacor) and one per cent mustard oil were mixed with the preferred food material, and the TDI of both the food materials were recorded. Thereafter, rats were fed on wheat (*Triticum aestivum*) grains. They were then exposed to the preferred food mixed with one per cent mustard oil and simple sorghum grains for 24 hours after 7th and 15th days from initial exposure to the sub-lethal dose of RH-787 and TDI of both the food materials was recorded.

RESULTS AND DISCUSSION

B. bengalensis preferred millet over sorghum during the first three days. The TDI of millet was significantly more than that of sorghum ($t = 7.08$ $P < .005$). On the subsequent four days, less millet was consumed to which 0.025 per cent RH-787 and one per cent mustard oil were mixed (Table 1). The difference in TDI of plain millet prior to the exposure to sub-lethal dose of RH-787 and of millet grains mixed with RH-787 and mustard oil is significant ($t = 3.64$ $P < .01$). There is no significant difference in TDI of plain sorghum consumed on subsequent four days when millet was mixed with RH-787 and mustard oil.

TABLE 1

MEAN DAILY INTAKE (g/100 g BODY WT.) OF SORGHUM AND MILLET BY *B. bengalensis* (GRAY)

Food	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day
Millet	10.1±1.01	11.66±1.07	9.71±1.46	6.46±1.02	1.56±0.95	2.95±1.22	4.5±1.52
Sorghum	4.96±1.61	5.9±0.98	1.45±0.57	2.16±0.71	1.19±0.40	1.72±0.61	2.39±0.60

On the 10th day, rats were provided with plain sorghum and millet mixed with mustard oil. TDI of millet was less than that of the initial three days of the experiment. On the 15th day, the consumption of both the food materials surpassed the initial level similar to that reported in *Gerbillus gleadowi* using sub-lethal dose of zinc phosphide (Rana *et al.*

1975). Thus, sickness developed due to feeding on sub-lethal dose of Vacor lasts for 7-15 days only. This implies that the poisoned bait is liable to be rejected by the rats if, it is provided before the completion of 15 days from the previous poison baiting. Hence the poison baiting for control in *B. bengalensis* should not be repeated before 15th day of previous poison baiting, using RH-787 as a rodenticide. However, more studies of the type as also the field trials need to be done before recommendations.

Present studies also reveal that 30% rats on 2nd and 3rd days of exposure and 10% rats on 4th day of exposure did not feed on poisoned millet.

When a second group of ten individuals of *B. bengalensis* was provided with plain sorghum and millet grains mixed with one per cent mustard oil for four days, there was no decline in the consumption of millet. Thus shyness can be ascribed to poison not mustard oil.

ACKNOWLEDGEMENTS

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REFERENCES

BARNETT, S. A., COWEN ,P. E., RADFORD, G. AND PRAKASH, I. (1975): Peripheral anosmia and discrimination of poisoned food by *Rattus rattus* L. *Behavioural Biol. 13*: 183-190.

PRAKASH, I. AND JAIN, A. P. (1971): Bait shyness of two gerbils *Tatera indica indica* Hardwicke and *Meriones hurrianae* Jerdon. *Ann. Appl. Biot. 59*: 169-172.

RANA, B. D., PRAKASH, I. AND JAIN, A. P. (1975): Bait shyness and poison aversion in hairy footed gerbil, *Gerbillus gleadowi* (Murray). *Proc. All India Rodent Seminar 1975* Ahmedabad (India): 58-60.

SOOD, M. L. AND DILBER, D. S. (1977): Acceptability of Vacor to *Bandicota bengalensis* (Gray) and *Tatera indica* (Hardwicke) in laboratory conditions. *Int. Pest Control.* 10-11, 20.

5. ON THE UNUSUAL OCCURRENCE OF THE COMMON DOLPHIN, *DELPHINUS DELPHIS* LINNAEUS IN LONGLINE CATCHES AT PORT BLAIR, ANDAMANS

The Exploratory Fishing Vessel, *Meenaprayas*, conducting longline tuna fishing off Port Blair, Andamans, had an unusual catch of the Common Dolphin, *Delphinus delphis* Linnaeus, on 30-3-1979. The black-skinned dolphin measuring 202 cm, weighed 68 kgs. The animal was dead when hauled on deck. It was not actually hooked in the mouth, but had fouled in the branch line of the longline gear.

The dolphin was fouled in the tail region and probably lashing at the bait hanging at the end of the line and playing around, the animal must have got entangled in the line. Being an air-breather, it has to come to the surface periodically to breathe and because of the fouling, it could not come to the surface and had drowned.

This kind of behaviour has also been observed in the case of the Thresher or Fox Shark, *Alopias vulpinus* (Bonnaterre), which is almost never hooked in the mouth which is small. This shark has a tail, as long as the body, with which it is believed to lash and frighten schools of fishes and feed on them. Similarly, this shark lashes at the bait and gets hooked in the tail. It is also hooked in the body or gills.

The Common Dolphin, which has world-wide distribution, is common in the Andaman Sea, often found swimming in large schools. True to the popular belief that it is fisherman's friend, they are invariably found along the bow of fishing vessels while steaming to the fishing grounds. Other Cetaceans and Sirenian are also common in the Andaman Sea. Reports of large whales blowing 'water-spouts' off Nancowry, Little Andaman and Middle Andaman are received frequently. Their identity has however not been established. Two large False Killer Whales, *Pseudorca crassidens* (Owen) were caught in gill nets off Port Blair on 27-7-1976 and 9-6-1977. A Dugong, *Dugong dugon* (Muller) was also caught in gill nets off Port Blair on 8-7-1977. They were inavriably dead while hauling for the same reason mentioned earlier.

T. E. SIVAPRAKASAM

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April 2, 1979.

6. LITTER SIZE OF SOME CAPTIVE WILD MAMMALS

This note presents some data on litter size of nineteen species of captive wild mammals observed at Nandankanan Biological Park, Orissa. The details of our observations are given in the Table.

TABLE

Serial No.	Species of mammal	Period of observation	No. of births recorded (Total no. of young born during the period)	Litter size (No. of births)	Average litter size
(1)	(2)	(3)	(4)	(5)	(6)
1.	TIGER (*Panthera tigris*)	1.7.1969 to 31.3.1978	8 (19)	1 (1) 2 (3) 3 (4)	2.38

2.	LION (*Panthera leo*)	1.7.1969 to 31.3.1978	13 (24)	1 (3) 2 (9) 3 (1)	1.85
3.	LEOPARD (*Panthera pardus*)	1.7.1969 to 31.3.1978	22 (54)	1 (2) 2 (12) 3 (6) 4 (1) 6 (1)	2.45
4.	GOLDEN CAT (*Felis temmincki*)	1.4.1972 to 31.3.1978	4 (5)	1 (3) 2 (1)	1.25
5.	JUNGLE CAT (*Felis chaus*)	1.7.1976 to 31.3.1978	2 (8)	3 (1) 5 (1)	4.00
6.	COMMON PALM CIVET (*Paradoxurus hermaphroditus*)	1.4.1964 to 31.3.1978	12 (36)	2 (3) 3 (7) 4 (1) 5 (1)	3.00
7.	COMMON MONGOOSE (*Herpestes edwardsi*)	1.7.1969 to 31.3.1978	1 (2)	2 (1)	2.00
8.	JACKAL (*Canis aureus*)	1.4.1964 to 31.3.1978	1 (3)	3 (1)	3.00
9.	RHESUS MACAQUE (*Macaca mulatta*)	1.7.1969 to 31.3.1978	7 (7)	1 (7)	1.00
10.	BONNET MACAQUE (*Macaca radiata*)	1.7.1969 to 31.3.1978	3 (3)	1 (3)	1.00
11.	INDIAN WILD BOAR (*Sus scrofa cristatus*)	1.4.1969 to 31.3.1978	40 (179)	1 (2) 2 (4) 3 (4) 4 (10) 5 (9) 6 (5) 7 (6)	4.48
12.	SAMBAR (*Cervus unicolor*)	1.7.1969 to 31.3.1978	60 (60)	1 (60)	1.00
13.	SPOTTED DEER (*Axis axis*)	1.7.1969 to 31.3.1978	74 (74)	1 (74)	1.00
14.	HOG DEER (*Axis porcinus*)	1.7.1966 to 31.3.1978	13 (13)	1 (13)	1.00

15.	BARKING DEER (*Muntiacus muntjak*)	1.7.1969 to 31.3.1978	23 (23)	1 (23)	1.00
16.	MOUSE DEER (*Tragulus meminna*)	1.7.1969 to 31.3.1978	6 (6)	1 (6)	1.00
17.	NILGAI (*Boselaphus tragocamelus*)	1.7.1969 to 31.3.1978	7 (8)	1 (6) 2 (1)	1.14
18.	BLACKBUCK (*Antelope cervicapra*)	1.7.1969 to 31.3.1978	64 (64)	1 (64)	1.00
19.	FOURHORNED ANTELOPE (*Tetracerus quadricornis*)	1.4.1974 to 31.3.1978	5 (8)	1 (2) 2 (3)	1.60

The observations of some of the earlier workers on litter size of these nineteen species of wild mammals along with a study of the above table follows.

TIGER: The litter size of eight births of this species in this park was from 1 to 3 with an average of 2.38 cubs.

The size of 79 litters born in zoos was 1 to 5 with an average of about 2.8 (Schaller 1972). The litter size is usually 2 to 3 but as many as 6 may be produced (Prater 1971). The litter size varies from 1 to 7 (Brander 1923).

LION: The litter size of thirteen births was from 1 to 3 with an average of 1.85 cubs.

The average of 64 lion litters in captivity was 2.5 (Cooper 1942). The usual litter size is 2, sometimes 3 and it may contain as many as 5 (Prater loc. cit.). The number of cubs per litter is 1 to 6 with an average of 3.04 and the litter size of one birth in one lioness in Dublin was 7 including three dead ones (Steyn 1951).

LEOPARD: The litter size of 22 births at this Park was from 1 to 6 with an average of 2.45 cubs. The birth of 6 cubs in one litter, observed in this Park, appears to be the maximum so far recorded.

The usual litter size is 2 to 4 (Prater, loc. cit.). The litter size of 27 births of leopards in the Zoological Gardens of London from 1839 to 1937 was 1 to 3 (Zuckerman 1953). The litter size of 39 births in Delhi Zoological Park was 1 to 3 with an average of 1.6 cubs (Desai 1975). The litter size of four births was 1 to 2 (Acharjyo 1970).

GOLDEN CAT: The litter size of four births of this species was 1 or 2 with an average of 1.25 kittens per litter.

The litter size of one birth is one (Acharjyo 1971), of two births is 1 to 2 (Acharjyo and Misra 1973) and 2 (Prater, loc cit.).

JUNGLE CAT: The litter size of two births was 3 and 5 with an average of 4 kittens per litter.

Acharjyo and Mohapatra (1977) state that the litter size of eight births of this species was from 3 to 5 with an average of 3.5 kittens per litter. Usually 3 to 4 young are born per litter (Asdell 1964).

COMMON PALM CIVET: The litter size of 12 births of this species was from 2 to 5 with an average of 3 young per litter.

The usual litter size is 3 to 4 (Prater, loc. cit.) and 3 to 4 but sometimes as many as 6 (Asdell, loc. cit.).

COMMON MONGOOSE: Only one birth with two young per litter was recorded.

The litter size is small, usually 2 to 3 (Prater, loc. cit.). The litter size of two births was 1 and 3 respectively (Acharjyo 1970).

JACKAL: Only one birth with three young per litter was recorded.

The number of young per litter varies from 2 to 6, mode 5, and mean 4 (Asdell, loc. cit.).

RHESUS MACAQUE: The litter size of seven births was always one.

All primates usually produce their young singly but occasionally twins are born (Prater, loc. cit.). Twins in this species are born about once in 90 to 100 births (Asdell, loc. cit.).

BONNET MACAQUE: The litter size of three births was always one.

INDIAN WILD BOAR: The litter size of 40 births was from 1 to 7 with an average of 4.48.

The litter size of this species is 4 to 6 (Prater, loc. cit.). The litter size of five births was from 4 to 7 young (Zuckerman, loc. cit.).

SAMBAR: The litter size of 60 births was always one and never twins.

One to two fawns are usually born per litter (Asdell, loc. cit.). One pair of twins was born in 41 births (Crandall 1965). Always single young was born to the 30 births recorded at Nandankanan Biological Park, Orissa upto 30th June 1969 (Acharjyo 1970). A single fawn per litter is the rule (Schaller 1972).

SPOTTED DEER: Always single young per litter was recorded at all the 74 births.

Usually one young per litter is born (Prater, loc. cit.). Only one pair of twins was noted in 225 births (Crandall, loc. cit.). Twins have been born only once in 80 births in the London Zoo (Asdell, loc. cit.). The litter size of 99 births was always one and never twins (Acharjyo 1970). One to three is usual with twins being common (Brander, loc. cit.). There were no twins in the 25 births at the Calcutta Zoo and 97 births at the Bombay Zoo (Schaller, loc. cit.).

HOG DEER: The litter size of 13 births was always one.

Single young was born to all the 32 births recorded at the New York Zoological Park (Crandall, loc. cit.). Twins have been recorded twice in 55 births in London Zoo (Asdell, loc. cit.).

BARKING DEER: The litter size of 23 births was always one.

The young born per litter is usually one and sometimes two (Prater, loc. cit.). Always single young were born to all the 30 births recorded in the Zoological Gardens of London (Zuckerman, loc. cit.). Twin birth was recorded once in 47 births (Acharjyo 1970).

MOUSE DEER: The litter size of six births was always one.

The litter size is generally two (Prater, loc. cit.; Asdell, loc. cit.).

NILGAI: The litter size of seven births was 1 or 2 with an average of 1.14 young per litter.

Always single young was born to all the eight births recorded at New York Zoological Park (Crandall, loc. cit.). There were two twins in four births (Acharjyo 1970). In about 61 births in the Zoological Garden of London, Zuckerman (loc. cit.) states that on an average twins were born in every alternate birth.

BLACKBUCK: The litter size of 64 births was always one and never twins.

One or two young are produced at a time (Prater, loc. cit.; Asdell, loc. cit.). Always single young and never twins was recorded in 97 births (Crandall, loc. cit.). The litter size of five births was always one (Acharjyo 1970).

FOURHORNED ANTELOPE: The litter size of five births was 1 or 2 with an average of 1.60 young per litter.

The litter size of six births was from 1 to 2 with an average of 1.83 (Acharjyo and Misra

1975). Twins were produced in 3 of the 5 births in the London Zoo (Asdell, loc. cit.).

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REFERENCES

ACHARJYO, L. N. (1970): Observation on some aspects of reproduction among common wild mammals in captivity. *Indian J. Anim. Health,* vol. X (2): 125-129.

———— (1971): A note on the birth of a Golden Cat (*Felis temmincki*) in captivity. *J. Bombay nat. Hist. Soc., 68* (1): 241.

————AND MISRA, R. (1973): Further notes on the breeding of Golden Cat (*Felis temmincki*) in captivity. *Indian Forester, 99* (1): 53-54.

———— ———— (1975): A note on the breeding habits of Fourt-horned antelope (*Tetracerus quadricornis*) in captivity. *J. Bombay nat. His. Soc., 72*(2): 529-530.

———— AND MOHAPATRA, S. (1977): Some observations on the breeding habits and growth of Jungle Cat (*Felis chaus*) in captivity. *J. Bombay nat. Hist. Soc., 74* (1): 158-159.

ASDELL, S. A. (1964): Patterns of mammalian reproduction, Second Edition, Cornell University Press, Ithaca ,New York.

BRANDER, A. (1923): Cited by Schaller, George, B. (1972).

COOPER, J. (1942): Cited by Schaller, George, B. (1972).

CRANDALL, LEE S. (1965): The Management of Wild Mammals in Captivity. The University of Chicago Press, Chicago and London.

DESAI, J. H. (1975): Observations on the Reproductive Biology and early Post-natal Development of the Panther *Panthera pardus* L. in captivity. *J. Bombay nat. Hist. Soc., 72* (2): 293-304.

PRATER, S. H. (1971): The Book of Indian Animals, Third (Revised) Edition, Bombay Natural History Society, Bombay.

SCHALLER, GEORGE B. (1972): The Deer and the Tiger. The University of Chicago Press, Chicago and London.

STEYN, T. J. (1951): Cited by Crandall, Lee S. (1965).

ZUCKERMAN, S. (1953): Cited by Crandall, Lee S. (1965).

7. OBSERVATIONS ON PARENTAL CARE OF A WOUNDED CHICK OF THE BRONZEWINGED JACANA, *METOPIDIUS INDICUS* (LATHAM)

While collecting waterbirds in a small fish tank at a swamp in Senpukur, Baj Baj, West Bengal (about 16 km SW. of Calcutta), on 3rd October 1977 around midday, a ricochetting shot from my .22 bore rifle accidentally hit a leg of one of the four chicks of a brood of the Bronzewinged Jacana. At the time of shooting they were following their parent on the other side of the tank.

Next day when I visited the tank I observed an extremely irritated and pugnacious Bronzwinged Jacana chasing and driving away almost all the birds which came to visit the tank for foraging, which included Cotton Teal, Lesser Whistling Teal, Pheasant-tailed Jacana, etc. It even chased and drove away a White-breasted Kingfisher and compelled a Little Grebe, an actual resident of the tank, to leave the place. I discovered that the hostile behaviour of the bird was only to protect the wounded chick which was unable to move with the others and was only able to feebly paddle in a small pool of water cleared by a parent bird by pushing or pulling apart the thick floating aquaic weeds with its bill. This rather cumbersome and laborious process of making clear spaces in the thickly entangled mass of aquatic weeds was observed to be performed repeatedly whenever the chick intended to move about. This behaviour of assistance to the wounded chick lasted till the midday of 5th October when the chick died.

During the period of observation, the three other broodmates of the unfortunate chick were unattended by the parent, but were found to be behaving normally like typical precocial chicks.

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8. BLACKNECKED CRANE IN BHUTAN AND ARUNACHAL PRADESH—A SURVEY REPORT FOR JANUARY-FEBRUARY 1978

For studying the status of the allegedly rare Blacknecked Crane, *Grus nigricollis* Przevalski, in the eastern Himalaya during winter, the Bombay Natural History Society, the Zoological Survey of India and the World Wildlife Fund—India, organised a joint expedition to Bhutan and Arunachal Pradesh during January-February 1978. Due to unavoidable reasons Dr. Sálim Ali of the BNHS and Dr. B. Biswas of the ZSI could not join the team. Mr. K. S. Lavkumar of the World Wildlife Fund—India and I from the Zoological Survey of India, therefore, conducted the survey. Earlier under the leadership of Dr. Sálim Ali, an expedition in search of the breeding ground of the crane had been undertaken in Ladakh during June-August of 1976, when the BNHS, the ZSI and the WWF-India, participated.

On the basis of the report by F. N. Betts (1954) from the Apatani Valley, Subansiri District of Arunachal Pradesh and the report furnished by Dr. B. Biswas, who led a faunistic exploration in central and eastern Bhutan from the Zoological Survey of India and actually found the cranes in the Tashi Yangtsi Valley in eastern Bhutan during 1973, together with the information supplied by the forest department of the Govt. of Bhutan, Central and Eastern Bhutan and Subansiri District (Apatani Valley in particular) in Arunachal Pradesh were chosen for the study.

ITINERARY:

In Bhutan: 11 Jan. 1978. Dep. Calcutta
15 Jan. 1978. Arr. Bumthang (Chamkhar Chu Valley), central Bhutan
20 Jan. 1978. Dep. Bumthang

(Due to road blocks produced by heavy snowfall in the higher reaches, the party was unable to proceed further east to the Tashi Yangtsi Valley. It left Bhutan on 23 Jan. 1978).

In Arunachal Pradesh: 24 Jan. 1978. Arr. Itanagar
27 Jan. 1978. Dep. Tarajuli (near Itanagar)
28 Jan. 1978. Arr. Apatani Valley (at Hapoli)
29-31 Jan. 1978. Halt at Tale Valley
1 Feb. 1978. Dep. Apatani Valley
2 Feb. 1978. Arr. Daporizo
4 Feb. 1978. Dep. Daporiza
5 Feb. 1978, Arr. Tarajuli
6-12 Feb. 1978. Halt at Tarajuli
13 Feb. 1978. Dep. Tarajuli
15 Feb. 1978. Arr. Calcutta.

The Blacknecked Crane a bird of the Tibetan Plateau, inhabited the grassy shores or reed-beds on the shores of the lakes of the Tibetan Plateau, or on their islands. It ranges from Ladakh in Kashmir east to Koko Nor region of Tibet and is believed to be migratory. Very little was known about this beautiful crane. In recent years, the Zoological Survey of India team, headed by Dr. B. Biswas found nine birds in the Tashi Yangtse Valley in eastern Bhutan during November of 1973. And lastly, in 1976, the breeding birds with nestlings were found in Ladakh by the joint expedition team headed by Dr. Sálim Ali.

Altogether we came across sixteen Blacknecked Cranes during our stay in Bhutan. At Gyetsa, 42 Km east of Tongsa, in the Kagang Chu Valley, a pair was seen foraging in the bogs as well as in the cultivated fields, soaked with melting snow. At Byakar, in Bumthang area, in the Chamkher Chu Valley, fourteen birds were seen. The composition of the flocks in Bumthang was nine adult and five juvenile birds. The flock broke up into family parties during the daylight hours. There were two pairs with two young, one pair with single young, one pair without any young, and a singleton male. The family parties collected in a flock at their roost before dusk. Segregated family parties were observed throughout the daylight hours, foraging in feeding grounds, usually in the bogs and marshes as well as in the ploughed fields. Each party maintained its own feeding territory. The gap between the feeding territories were usually about a kilometre or more. Only the mateless male was seen foraging near the couple without young. But he was not allowed to come closer than about a hundred metre or so. Each family party, even with the young foraged in its own particular field. Young fed independently of their parents but their movements from place to place or when alarmed were always together. Before dusk, each party came down to a particular field not far from the roost, where they had their last feed. The congregated family parties had their preening and other rituals and just at dusk, they simultaneousely left for their roosting ground in a marshy fallow field at the foot of a hillock somewhat away from the river bed. Whether at their last feeding ground or at roost, the parties maintained their separate entities. At daybreak, the parties were seen coming out one after another over the river and settling on their respective feeding grounds. Usually they foraged in a particular field throughout the day unless disturbed. They took no notice of the local people in traditional costumes and would allow them to come within about 20 metres, or so, but were visibly suspicious and cautious at the sight of persons not in the familiar apparrel. They became alert and agitated at the report of a .22 rifle and invariably left the feeding ground, suggesting a familiarity with firearm sounds apparently in their breeding grounds, as they have never been shot at in Bhutan. On the day we left Bumthang ,a fresh pair was seen. This, apparently, was the pair we saw at Gyetsa on 15 January, for we did not see it there on our return journey.

In the Apatani Valley, Subansiri District of Arunachal Pradesh, the recorded wintering ground of the Blacknecked Crane, a thorough search for the bird was conducted, but without any success. The crane is a well known bird and has found its place in the folk-lore. Information from local sources suggests that some twenty years back flocks of twenty or thirty Blacknecked Crane used to land in the Apatani Valley during the winter, when on such an occasion F. N. Betts encountered them in 1954. At that time the bird enjoyed protection from the local inhabitants. Since then, however, its population in the valley has started dwindling, chiefly due to human interference by way of hunting. Over the years, apparently, the habits of the local inhabitants has changed. During recent years, the free use of firearms, has made persecution of this bird much easier, so that the population of the Blacknecked Crane has now dwindled alarmingly, so much so that during the last two years no crane has been sighted in the Apatani Valley. The last pair that appeared in the Apatani Valley near Hang Village in February of 1975 was soon collected for the pot within an hour or so of its landing. Since then cranes are not flying over this otherwise beautiful country, an erstwhile favourite wintering ground.

SUBHENDU SEKHAR SAHA

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9. THE BLUECHEEKED BEE-EATER *MEROPS SUPERCILIOSUS* LINNAEUS IN KUTCH

The Bluecheeked Bee-eater has so far been believed to be only a passage migrant in Kutch. However on June 25, this year I saw one young bird which appeared to have just left its nest, since it kept on sitting in the same position on an electric wire and was being frequently fed by one adult bird. This was at the Devisar Tank, about 16 kms. north of Bhuj. While I, along with the local bird-enthusiasts, Messers Bapat, Varu and others, watched this young bee-eater no other adult bird except one was seen. Almost all the insects caught and fed to the young were dragonflies (sp ?). The parent bird, after catching its prey, would settle down at some distance on the wire and only after properly killing the insect feed the young one. This, I think, is the first breeding record of this bee-eater in Kutch.

Dr. Sálim Ali did not come across the Bluecheeked Bee-eater in Kutch in any season except during their outward passage migration in Sept.-Oct. They are known to breed in Saurashtra (Dharmakumarsinhji—BIRDS OF SAURASHTRA—specific breeding areas not mentioned). I have seen them off and on in Kutch during summer. I first came across the bird on May 2, 1950; this too was at the same place (Devisar), and I saw them in the Banni on October 6, 1950, then on November 8, 9, 10, 1973 on the sea coast of Mandvi in scattered parties in a stretch of about 19 kms. from

Raval Pir to Panchatiya village. These birds were obviously on their way to their wintering grounds.

JUBILEE GROUND,
BHUJ, KUTCH,
August 12, 1978.

M. K. HIMMATSINHJI

10. THE COMMON HAWK-CUCKOO, *CUCULUS VARIUS* VAHL IN KUTCH

The Common Hawk-Cuckoo or Brainfever Bird is found practically all over the country, and I have heard and seen it quite often in Saurashtra (Wankaner) and elsewhere in India. However, I had never come across it in Kutch until 23rd August this year. So far as I know, Dr. Sálim Ali has not recorded it here during his surveys prior to the publication of the BIRDS OF KUTCH. Thus this sighting of *Cuculus varius* by me seems to be the first record for the area, at least after the publication of the list of birds recorded by Stoliczka and Hume (BIRDS OF KUTCH, p. 171).

I am inclined to put this bird down as an extremely rare visitor or a vagrant into Kutch.

JUBILEE GROUND,
BHUJ, KUTCH,
September 1, 1978.

M. K. HIMMATSINHJI

11. A NEW NESTING SITE OF COMMON MYNA, *ACRIDOTHERES TRISTIS* (LINNAEUS), IN THE PUNJAB

(*With two photographs*)

The common myna, *Acridotheres tristis* (Linnaeus), has been reported to nest in holes in trees, rock faces, vertical earth banks, walls of buildings and wells (Whistler 1963, Ali and Ripley 1972 and Ganguly 1975). Occasionally it also builds untidy nests in trees. During July 1977, this bird was seen exploiting a difrent nesting site in the Punjab. We saw this bird making use of wheat hay stacks for nesting purposes. A wheat hay stack is locally known as *kup*, a dome shaped structure about 3 to 4.5 metres high and approximately of the same diameter (Photo.1).

Only one pair of birds usually nests in a *kup*. The mynas make a slit at the top of the *kup* by pulling out straw and an entrance hole is made at the bottom of the slit (Photo.2). There is sufficient place for laying eggs and raising young inside the hole. The eggs are laid directly on the flat platform of hay. However, in some nests it was observed that the bird had placed a few dry leaves and feathers.

This nesting site was discovered accidentally on 9th July, 1977 in an agricultural farm at village Darawan, Distt. Jullundur (Punjab). Examinations of the nest in the *kup* revealed

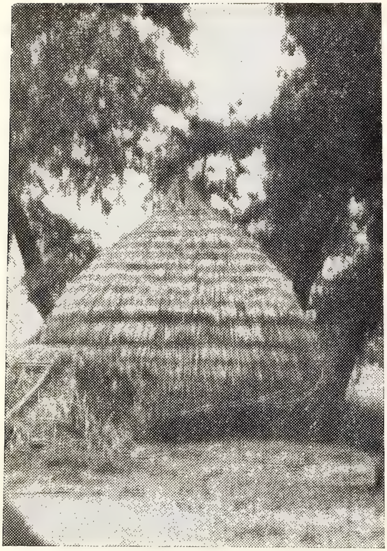

Photo.1. A *kup* showing entrance hole of common myna nest at its top.

the presence of five eggs of the common myna on the flat platform of wheat hay. On the same day, all *kups* of that village were examined and the majority of these had common myna nests.

In 1978, during mid-July to mid-August, 286 *kups* were observed at random in the districts of Hoshiarpur, Jullundur and Ludhiana. Out of these, 151 contained nests of common myna. This number clearly indicates a change in the nesting behaviour of this bird which is probably due to the changed ecological conditions.

Photo.2. Top portion of the same *kup* (enlarged) showing common myna coming out of the nest.

The nest in the *kup* is well protected against rain and sun and is not easily approached by predators. Even if rain water penetrates to some extent, the structures quickly dry up owing to their porous nature. Besides this, the birds need not collect nesting material, and can lay eggs directly on hay. In using other nesting sites, mynas are known to stuff nesting holes with twigs, roots, tow and rubbish (Ali & Ripley 1972).

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REFERENCES

ALI, S. & RIPLEY, S. D. (1972): Indian Myna *Acridotheres tristis* (Linnaeus). In: Handbook of the birds of India and Pakistan. pp. 177-180. Oxford University Press, Bombay, London and New York.

GANGULY, U. (1975): Common myna. In: A guide to the Birds of the Delhi Area. pp. 207-08. Indian Council of Agricultural Research, New Delhi.

WHISTLER, H. (1963): The common mynah. In: Popular Handbook of Indian Birds. pp. 203-04, Oliver and Boyd. Edinburgh and London.

12. ON THE TAXONOMIC STATUS OF THE EASTERN GHATS HILL MYNA, *GRACULA RELIGIOSA PENINSULARIS* WHISTLER AND KINNEAR, 1933 [AVES: STURNIDAE]

The Eastern Ghats population of the Hill Myna was separated from the Northern Hill Myna, *Gracula religiosa intermedia* A. Hay, 1844, by Whistler and Kinnear (1933) as *Gracula r. peninsularis* with Sambalpur district, Orissa, as the type-locality, on the basis of its being smaller in size and in having finer and shorter bill. Ripley (1961) and Ali and Ripley (1972) also accepted them as separate subspecies.

However, while working out some recent collections of birds from Orissa made by me in 1976 and 1977, I find that my specimens of the Hill Myna are very difficult to separate from *Gracula r. intermedia.* An attempt has, therefore, been made to settle the taxonomic status of *Gracula religiosa peninsularis* on the basis of the material present at the Zoological Survey of India and the Bombay Natural History Society. The differences between the populations from Orissa and northern India are given in Table.

TABLE

MEASUREMENTS IN MM. (AVERAGES IN PARENTHESIS)

Wing		Tail	Bill	Wing-Tail Index	Wing-Bill Index
Gracula religiosa intermedia:					
Nepal					
1♂ :	170	78	31	45.88	18.23
1♀ :	170	79	31	46.47	18.23
Darjeeling					
3♂ :	16-166 (162.66)	71-74 (72.66)	31-33 (32)	43.82-45.62 (44.67)	18.91-20.62 (19.76)
3♀ :	168-172 (170)	78-80 (76.66)	34 (34)	45.34-47.05 (46.27)	20-20.34 (20.19)
Bhutan (Data taken from Dr. B. Biswas)					
3♂	160-165 (161.66)	75-79 (76.33)	30-31 (30.66)	46.87-47.87 (47.20)	18.18-19.37 (18.97)
3♀ :	158-172 (166.66)	72-81 (77.66)	32-33.5 (32.83)	45.56-47.64 (46.57)	18.82-20.88 (19.72)

Arunachal Pradesh					
2♀ :	164-168	74-75	31-33	44.64-45.12	18.90-19.64
	(166)	(74.50)	(32)	(44.88)	(19.27)
Khasi and Jaintia Hills, Meghalaya					
3♂ :	161-171	74-77	34(2)	45.02-45.96	19.88-20.60
	(165.66)	(75.33)	(34)	(45.47)	(20.24)
1♀ :	162	78	34	48.14	20.98
Garo Hills, Meghalaya					
2♂ :	168-170	73-74	32-34	42.94-44.04	18.82-20.23
	(169)	(73.50)	(33)	(43.49)	(19.52)
Goalpara					
2♂ :	167-174	77-79	32-34	45.40-46.10	18.39-20.35
	(170.50)	(78)	(33)	(45.75)	(19.37)
Orissa population (=*Gracula religiosa peninsularis*):					
Chahala, Mayurbhanj Dist.					
2♂ :	160, 161	77, 78	30, 32	48.12, 48.44	18.63, 20
	(160.50)	(77.50)	(31)	(48.28)	(19.31)
1♀ :	156	76	31	48.71	19.87
Kotagarh, Phulbani Dist.					
5♂ :	156-168	72-80	33-34	43.97-47.14	19.64-21.79
	(163.20)	(75)	(33.75)	(45.85)	(20.79)
3♀ :	154-155	69-74	30-32	44.80-47.74	19.35-20.64
	(154.66)	(71)	(31)	(45.89)	(20.03)
Madpad, Koraput Dist.					
5♂ :	154-169	74-84	32-34	42.01-48.44	18.93-21.42
	(162.80)	(79)	(33)	(46.85)	(20.29)
4♀ :	157-162	76-80	31-33	46.91-50.31	19.13-21.01
	(160)	(78)	(31.75)	(48.75)	(19.84)
Chitrakunda, Koraput Dist.					
2♂ :	154, 163	74, 79	32, 33	48.05, 48.46	20.24, 20.77
	(158.50)	(76.50)	(32.50)	(48.25)	(20.50)
Kutri and Gonia, Puri Dist.					
2♀ :	155, 160	75,77	33	48.12, 48.38	20.62, 21.29
	(157.50)	(76)	(33)	(48.25)	(20.95)

It appears from the above data that *intermedia* and *peninsularis* cannot be separated from each other on the basis of either size or bill characters. Though *intermedia* is generally slightly larger than *peninsularis*, only about 50% and not 75% of the population can be separated, and there is complete overlap in the size of the bill between them, and in their wing-tail and wing-bill indices. Hence, *Gracula religiosa peninsularis* should be considered a synonym of *Gracula religiosa intermedia.*

I am grateful to Dr. B. Biswas, Zoological Survey of India, Calcutta for his valuable suggestions and for going through the manuscript and to Dr. S. D. Ripley of the Smithsonian Institution, Washington, D. C., for his wise advice in this matter. He also agrees with my conclusion.

ZOOLOGICAL SURVEY OF INDIA,
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REFERENCES

ALI, S. AND RIPLEY, S. D. (1972): Handbook of the birds of India and Pakistan, together with those of Nepal, Sikkim, Bhutan and Ceylon, *5*: 195. Oxford University Press, Bombay.

RIPLEY, S. D. (1961): A synopsis of the Birds of India and Pakistan, together with those of Nepal, Sikkim, Bhutan and Ceylon. P. 304. Bombay Natural History Society, Bombay.

WHISTLER, H. AND KINNEAR, N. B. (1933): The Vernay Scientific survey of the Eastern Ghats. Ornithological Section, *J. Bombay nat. Hist. Soc.*, *36*: 586.

13. EGG-BOUND DEATH OF A PURPLERUMPED SUNBIRD AT BAJ BAJ, WEST BENGAL

The Purplerumped Sunbird, *Nectarinia zeylenica sola* (Vieillot), breeds throughout the year. However, there is marked increase in breeding activities in lower West Bengal from the early part of March to May.

Early in February this year, with the first incursion of the south wind that brings humidity from the Bay of Bengal and heralds the advent of spring in lower Bengal, I noticed a female Purplerumped Sunbird building its pouch-like pear-shaped nest which lacked the porch-like projection over the entrance, suspended from a thin branch of a Sourlime tree [*Citrus aurantiifolia* (Christm.) Swingle] at a height of *c.* 1.5 m from the ground at Baj Baj, 24-Parganas District, West Bengal. The nest was built entirely by the female, while her mate did the 'watch and ward' duties. She took six days for completion of the nest, from 5th February to 11th February 1977.

The first egg of the clutch was laid on 20th February. The bird was found dead at her nest on the 22nd morning. Its head was tucked inside the wall of the nest-chamber and the lower part of the abdomen bulged out in such a way that the brood-patch was completely exposed, and the anal circlet was curved inward. The presence of a ring formed by pollen and nectar at the distal part of its bill indicated that it had its early morning feed.

On postmortem it was found that the bird died egg-bound. A thinly shelled and properly shaped egg measuring 15.6 × 11.7 mm was found in the distal part of the oviduct. Traces of haemorrhage in the brain and in the mouth cavity probably the effect of egg-binding were also noticed.

BAJ BAJ,
WEST BENGAL,
July 1, 1977.

SRIKUMAR CHATTOPADHYAY

14. OCCURRENCE OF THE BENGAL BLACK ROBIN, *SAXICOLOIDES FULICATA ERYTHRURA* (LESSON) [MUSCICAPIDAE: TURDINAE], AND THE ASSAM PURPLE SUNBIRD, *NECTARINIA ASIATICA INTERMEDIA* (HUME) [NECTARINIIDAE] IN ORISSA STATE

While working out a collection of birds from Orissa State made by Dr. V. C. Agrawal in 1972, Dr. A. K. Mondal in 1972, Shri P. K. Das in 1973 and by me in 1976 and 1977, I came across two species of birds, namely, the Bengal Black Robin, *Saxicoloides fulicata erythrura* (Lesson) [Musicapidae: Turdinae] (15 examples) and the Assam Purple Sunbird, *Nectarinia asiatica intermedia* (Hume) [Nectariniidae] (two examples). According to the standard literature on Indian ornithology like Baker (1926) and Ali and Ripley (1973 and 1974), these have not so far been reported from Orissa. The particulars of the specimens are as follows:

Saxicoloides fulicata erythrura (Lesson)

Material.—♂: 2, Tikarpara, Dhenkenal district, January 8 and 11, 1972; 1, Lathore, Bolangir, December 19, 1972; 2, Rairakhol, Sambalpur district, January 26 and 27, 1973; 2, Madpad, Koraput district, February 21 and 24, 1974; 4, Balimela, Koraput district, March 6, 7 and 8, 1977.

♀: 1, Charmal, Sambalpur district, March 27, 1976; 2, Balimela, Koraput district, March 7, 1977; 1, Chitrakonda, Koraput district, March 17, 1977.

Measurements (in mm.):

	Wing	Tail	Bill
11♂:	68,69(3),70,71(3), 74(2),75	59(3),60,61,62, 63(3),64,65	16(7),17(4)
4♀	66,67,68,69	58(2),60,62	15,16(3)

Distribution: Ali and Ripley (1973) stated that it is known from eastern Bihar, West Bengal and adjacent areas of Bangladesh.

This is the first record of the occurrence of this subspecies in Orissa.

Nectarinia asiatica intermedia (Hume)

Material.—♂: 1, Badrama, Sambalpur district, December 27, 1972; 1, Madpad, Koraput district, February 20, 1977.

Measurements (in mm.): 2♂: Wing 56, 58; Tail 37, 38; Bill 22, 23.

Distribution: According to Baker (1926) and Ali and Ripley (1974) this subspecies is found in Assam and Bangladesh. The present specimens, therefore, constitute the first record of its occurrence in this region.

N. MAJUMDAR

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REFERENCES

ALI, S. AND RIPLEY, S. D. (1973, 1974): Handbook of the birds of India and Pakistan, together with those of Nepal, Sikkim, Bhutan and Ceylon. *9*: 61; *10*: 37.

BAKER, E. C. S. (1926): Fauna of British India, Birds. *3*: 398. Taylor & Francis, London.

15. DISPERSAL OF BAYAS WITH RECORDED DISTRESS CALLS

INTRODUCTION

The Indian Baya (*Ploceus philippinus*) is a common crop pest causing considerable damage to cereal crops. They commence visiting the fields in flocks from the time the crops are in milky stage of grain and continue to damage till the harvest of the crop (Hamid Ali *et al.* 1980). Though various control measures have been advocated none has given a satisfactory result. Some investigators (Frings and Jumber 1954, Frings and Frings 1963 and 1967, Pearson *et al.* 1967) used the distress calls to frighten away and disperse the birds from their roosts and bird pests from feeding areas. The present experiment was conducted to investigate whether recorded distress calls have any repellent effect in dispersing the bayas from crops.

MATERIALS AND METHODS

The roosting site of bayas selected for the present study was situated in the midst of the Agricultural University experimental paddy fields approximately one kilometre from the Veterinary College, Rajendranagar, Hyderabad. About 350 bayas roosted in a bush. These bayas caused heavy damage to the surrounding experimentl fields. The acoustic equipment used for the experiment consisted of microphone, stereo tape recorder of high quality, 30 W amplifier, speakers and 12 V battery. The distress calls of bayas were recorded for a continuous period of three minutes in the laboratory. The recorded distress calls have high signal-to-noise ratio.

The experiment was conducted during March 1978. The amplifier feeding a speaker, and the tape recorder playing the recorded distress calls were operated at a distance of 200 metres from the roosting site. On March 1, 1978 at 5 p.m. about 350 bayas arrived in groups at their roosting place. Prior to the arrival of bayas the speaker was kept hidden on one side of the roosting bush. After 15 minutes of the arrival of bayas and as they began to settle down, the distress calls were played for 30 seconds. Immediately the birds responded to the distress calls and showed signs of restlessness and moved to the other side of the bush. After an interval of 5 minutes the distress calls were again played for 40 seconds. Groups of bayas came out of the bush and hovered around the speaker at a height of about 12 metres and flew off in a northern direction. The birds did not return to the site to roost on that night.

The same experiment was repeated at intervals of 2 to 7 days. The experimental data on the effect of distress calls on baya population are shown in the Table.

TABLE

EFFECT OF DISTRESS CALLS ON THE POPULATION OF BAYAS DURING THE EXPERIMENTAL PERIOD

Date	No. of bayas in the bush	Time of arrival of the bayas (in hours)
1-3-1978	350	17.00
3-3-1978	350	16.50
6-3-1978	200	17.40
8-3-1978	80	17.30
10-3-1978	49	18.00
13-3-1978	20	18.20
16-3-1978	—	—
23-3-1978	—	—
30-3-1978	—	—

In each trial the bayas came out of the bush in small groups, hovered around the speaker without actually settling down and after 6 to 8 seconds activity at the roosting site, the bayas dispersed.

DISCUSSION

Observations recorded in three trials after the last batch of bayas were dispersed show that the birds did not return to their night roosts till the end of the experimental period, i.e. till 30 March when the last observation was taken.

Pearson *et al.* (1967) observed that starlings were not habituated to distress calls contrary to the findings of Frings & Frings (1963). In the present studies the dispersal of bayas from their roosting site indicates that they are not habituated to the distress calls which is in confirmation with findings of Pearson *et al.* (1967). From the above observations it is inferred that the bioacoustic method is effective in moving bayas from their roosts. Further experiments with regard to the effective distance of audibility in cropped area, duration of the effect and the response of the bird pests toward the distress calls of other species are in progress.

ACKNOWLEDGEMENTS

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REFERENCES

FRINGS, H. AND FRINGS, M. (1963): Pest Control with sound. Part II. The problem with vertebrates. *Sound* 2(i): 39-45.

———— (1967): Behavioural manipulation (visual, mechanical and acoustical). In "Pest Control" (Kilgore, W. W. and Doutt, R. L. ed) Academic Press, New York. 387-454.

———— AND JUMBER, J. (1954): Preliminary studies on the use of a specific sound to repel starlings (*Sturnus vulgaris*) from objectionable roosts. *Science. 119* (3088): 318-319.

HAMID ALI, M., SINGH, T. G. M., BANU, AZIZ, RAO, M. A. AND JANAK, A. T. (1980): Observations on the food and feeding habit of Baya weaver (*Ploceus philippinus*). *J. Bombay nat. Hist. Soc. 75* (supplement): 1198-1204.

PEARSON, E. W. SKON, P. R. AND CORNER, G. W. (1967). Dispersal of urban roosts with records of starling distress calls. *J. Wildl. manage. 31*(3): 502-506.

16. ON NESTING ASSOCIATION OF THE WHITEBACKED MUNIA, *LONCHURA STRIATA* (LINNAEUS) WITH THE MOUND-FORMING TREE-ANT, *CREMATOGASTER ROGENHOFERI* MAYR

The nesting association of birds with aggressive social insects like bees, wasps and ants is well known. As early as 1866, Ramsay wrote of *Gerygone olivacea,* the Whitethroated Gerygone: "The nests are often placed in trees covered with ants, which insects are often on the nests themselves but do not, as far as I am aware, cause the bird any anxiety." Since then some work has been done on this subject by various authors such as North (1904, 1909), Jackson (1907), Maclaren (1950), Chisholm (1952) and a collation with critical analysis of all those works has been done by Hindwood (1955).

In India the only bird that has so far been recorded to form its nesting association with tree-ants (*Crematogaster, Plegiolepis,* etc.) is the Rufous Woodpecker, *Micropternus, brachyurus* (Vieillot) [Baker (1927), Ali & Ripley (1971)], though the nesting association of the Blackheaded Munia, *Lonchura malacca* (Linnaeus), with paper-wasps has been recorded from Australia (Hindwood 1950), where the bird was imported from the East as a cage-bird.

The present paper deals with a four-year study on the nesting association of the Whitebacked Munia, *Lonchura striata* (Linnaeus), with the paper nest tree-ant, *Crematogaster rogenhoferi* Mayr, at Baj Baj, 24 Parganas district, West Bengal.

In the year 1974, a pair of Whitebacked Munia built their nest in a *Kamini* tree (*Murya paniculata* Jack) at a height of *c.* 3 m from the ground at the edge of a pond. They commenced building the nest on 5th August and completed it on 14th August. On close inspection which was only possible after a good number of ant-bites, it was found that the nest was constructed very close to a live, oval-shaped nest of tree-ants. The parent birds were able to rear successfully all the four young of the brood that year.

The female bird was caught in a mistnet and was marked by clipping its middle claw of the right foot.

Next year, the same female along with a male again commenced building their nest in the same bough close to that nest of ants on 3rd August 1975 and completed it on 11th August 1975. Unfortunately, however, after the female had laid the first egg of the clutch the local village boys damaged the nest along with the egg on 18th August 1975. Three weeks later, on 9th September 1975, to my utter surprise, I found that the pair had again started building another nest at the same spot, and completed its construction on 19th September 1975. This time they were successful in raising their brood.

In 1976 in order to study the habitat and associate preference, I intentionally damaged the newly built nest on 27 August. They rebuilt the nest on 7th October at the same spot.

A very interesting thing happened this year (1977). The same female bird and a male built their nest at exactly the same spot as in the previous years, commencing on 15th September and completing it on 24th September. However, soon after the tree-ant nest was damaged by torrential rain on 6th October, the birds deserted the nest and shifted to a nearby *Bakul* tree (*Mimusops elengi* Linnaeus) that was heavily infested with tree-ants, to construct another nest.

From the above observation it appears that the Whitebacked Munia prefers such an association with the ants, and that the nesting activities of the pair are tolerated by the ants, which can also differentiate the intruders, as whenever I ventured near the nest, the ants rushed towards me in hundreds, holding their abdomen skywards like anti-aircraft guns and within a very short time I found myself covered with ants all stinging, until I made a hurried retreat. A female Longtailed Mouse, *Vandeleuria oleracea* (Bennett), who built her nest in the same tree, was, however, unable to rear her young because of the ants.

It appears that the munias were aware of the arms of protection provided by the ants, because there is no convincing alternative for the evaluation of such an association known at present.

ACKNOWLEDGEMENTS

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REFERENCES

ALI, S. & RIPLEY, S. D. (1971): Handbook of birds of India, Pakistan and Ceylon. *10*. Oxford University Press, Bombay.

BAKER, E. C. S. (1927): Fauna of British India including Ceylon and Burma. *6*. London.

CHISHOLM, A. H. (1952): Bird insect nesting association in Australia. *Ibis*. 94: 395-405.

HINDWOOD, K. A. (1955): Bird/Wasp nesting association. *Emu 55*: 263-274.

JACKSON, S. W. (1907): Catalogue and data of Jacksonian Oological collection: 72. Sydney.

MACLAREN, P. I. R. (1950): Bird-ant nesting associations. *Ibis 92*: 564-566.

NORTH, A. J. (1904): Nests and eggs of birds found breeding in Australia: 1-194. Sydney.

——— (1909): Notes on the Nesting-site of *Gerygone personata*, Gould. *Rec. Aust. Mus. 7*: 186-188.

17. BIRD PESTS TO RICE AT BUMBONG LIMA, PROVINCE WELLESLEY, WEST MALAYSIA

From April 1975 through March 1977, I conducted an investigation of bird pests to rice in northwestern peninsular Malaysia. The study came under the auspices of the United States Peace Corps/Smithsonian Institution Environmental Program, and was conducted in cooperation with the Malaysian Agricultural Research and Development Institute (MARDI). My study area consisted of 15 ha. of experimental rice fields at the MARDI Rice Research Center (RRC) at Bumbong Lima in Northern Province Wellesley. The RRC conducts research in the areas rice breeding and varietal improvement, rice plant physiology, agronomy, and crop protection, which includes such pests as rodents, insects, weeds, fungus and bacteria. Bumbong Lima is situated in one of Malaysia's most productive rice-growing areas. Much of the agricultural land is irrigated so that two crops of rice are harvested annually.

Throughout Asia, numerous species of seed-eating birds cause extensive damage to cereal grain crops such as rice. In West Malaysia, the main bird pests are four species of munia in the genus *Lonchura* (Estrildidae), and the Baya Weaver, *Ploceus philippinus* (Ploceidae). Munias have long been popular with aviculturalists, and many cage studies of their behavior have been made, but relatively little research has been conducted under natural conditions. On the other hand, the Baya Weaver has been the subject of many field studies, particularly with regard to its nesting behavior, but as with the munias, its role as a crop pest has not received much attention. This study was designed to gather data on movements, food habits, and breeding seasonality of the bird pests to rice in the Bumbong Lima area.

At the RRC, the principal rice-eating species were the Sharp-tailed Munia, *Lonchura striata;* the Spotted Munia, *L. punctulata;* and the Baya Weaver. The Chestnut Munia, *L. malacca,* and the White-headed Munia, *L. maja,* occurred abundantly in fields within 15 km of the RRC, but only seldom did I observe them on the study area.

The results of my study are summarized below under three main headings. Additional data or details of the investigation are available from me upon request.

Movements

I instituted a ringing program early in the study to obtain data on the movements of the three target species. During 1975, numerous ringed birds were retrapped at the RRC, but reports of ringed birds being trapped out-station were non-existent. To spur interest among farmers, I advertised in the local newspapers and on the radio a reward of M$2.00 (US$0.80) for out-station recoveries of ringed birds. The response was very enthusiastic, and a total of 50 recoveries resulted.

The Sharp-tailed Munia (STM) was by far the most numerous of the three target species on the study area. Regular censuses showed that STMs were most abundant during the months of March and September, with lows occurring in May and November. This pattern of abundance corresponded with the pattern of rice availability at the RRC.

Overall, I ringed 1988 STMs, and recorded 250 on-station retraps. The high rate of retraps indicates that STMs in the Bumbong Lima area had rather localized movements and returned regularly to the RRC to feed. There were 11 out-station recoveries of STMs, all from within 10 km of the RRC, again indicating a localized pattern of movement.

At the RRC, field counts of Spotted Munias (SPM) tended to be low during the first eight months of the year and high during September-December, probably due to the addition of juvenile birds to the population. A total of 531 SPMs was ringed during the study, but only 14 on-station retraps were recorded. This suggests either that this species moves about more extensively than do STMs, or that SPMs are more successful in avoiding being recaptured. Two out-station recoveries of SPMs were reported, one from 16 km south of the RRC.

Numbers of Baya Weavers (BW) fluctuated quite drastically from month to month with no apparent pattern. Altogether, 863 BWs were ringed and 193 were retrapped on-station. Most of the retraps occurred within one month of the ringing date, and retraps over longer intervals were uncommon, indicating that once they left the study area, BWs seldom returned, unlike STMs which regularly came back. There were 37 out-station recoveries of BWs. About half of these were from locations greater than 10 km from the RRC, suggesting that BWs ranged over a greater area than did the munias.

Food Habits

The food habits of the three target species were examined through field observations and crop analyses. In addition, cage studies were conducted on the munias.

In the field, STMs were observed eating rice almost 75% of the time. The only other food item recorded in the field was the filamentous green algae, *Spirogyra*. Rice was also the most common food item for SPMs in the field, but they were also frequently seen eating *Echinochloa*, a common weedy grass that was abundant at certain times of the year. SPMs also ate algae, but not as often as did the STMs. BWs were never seen eating algae. Rice comprised the bulk of their diet, according to the field observations, although they frequently were seen in tall grass and reed areas adjacent to the rice fields.

Crop analyses performed on a total of 231 birds largely confirmed the field observations. Very little other than rice and algae was found in the crops of STMs. SPMs ate rice more often than any other food item, but seeds of wild grasses as well as algae were recorded with appreciable frequency. No algae was found in BW crops, two-thirds of which contained rice. Seeds of the grass *Paspalum* sp. and various sedges (Cyperaceae) were frequently found. Insect matter was found in two BW crops.

In the cage experiments, munias, singly and in pairs, were given a choice of two food items on each of five days. In the first series, the food items were ripe rice and the grass *Echinochloa crusgalli*. In the second series, rice at various stages of ripening was used. The STMs tested usually showed a preference for rice over *Echinocloa* whereas the SPMs displayed no preference. This is very consistent with the field observations. In the second series, STMs tended to prefer younger, milky stage rice over rice that was at least two weeks older, although both were eaten. No distinction was made by the birds between rice that differed in age by just one week.

Breeding Seasonality

The breeding seasonality of the two munia species was examined in three ways: the presence of juvenile-plumaged birds in the population, the gonad size of autopsied birds, and field observations of nesting activity.

The juvenile plumages of both munia species persist until about three months of age. Among the STMs, birds in juvenile plumage were most common during the periods March-April and September-October. These periods were also the times of maximum rice abundance at the RRC. The peak time of juvenile-plumaged SPMs was September-December, although birds in juvenile plumage were present all year round.

Among the adult-plumaged STMs of both sexes, the greatest periods of reproductive activity, as indicated by enlarged gonads, were January-February and July-August, just prior to the periods of greatest juvenile abundance in the population. Thus, it appears that STMs at the RRC have two main periods of breeding activity annually.

Not enough SPMs were collected to determine their seasonal gonadal condition.

STM nesting activity was determined regularly at five locations outside of Bumbong Lima, and local (within 1 km) rice conditions were assessed at the same time. These observations showed that active or very active nesting occurred 12 times when rice was locally available and 6 times when it was not. On the other hand, only once was nesting *not* recorded when rice was available in local fields. The remaining 13 observations when no, or slight, nesting was recorded, there was no locally available rice. Thus, there was a definite association between STM nesting activity and nearby rice conditions.

It is hoped that the results of this study will lead to a better understanding of the relationships between certain bird species and the rice crop in Malaysia, and that these results will provide a basis for further studies.

231 Gibson Road,
Annapolis, Maryland 21401,
U.S.A.,
March 15, 1978.

MICHAEL AVERY

18. NOTES ON SEXING CROCODILIANS
(*With two plates*)

The need for sexing crocodilians for captive propagation or for release is self evident. Several authors have reported the effectiveness of the simple cloacal probe technique. The crocodile is held and turned on its back. The cloacal area is cleaned with water, finger (close-cropped nail advisable) is inserted to feel for the presence or absence of the penis.

Male crocodilians possess a single organ, rooted to the interior ventral wall of the cloaca immediately anterior to the anal vent. Normal rigidity of the organ permits contact when probed at a depth of 8 centimetres or less in an animal 3 to 4 metres in length. The absence of a rigid organ within the cloaca of the female reveals only a vacant chamber when probed. The small flaccid clitoris of the female cannot easily be confounded with the penis of the male if a minimum specimen size limitation of 75 cm is observed, particularly when dealing with individuals of the genus *Tomistoma* and *Gavialis* (Brazaitis 1968).

With smaller mugger (70-80 cm) it is often impossible to insert a finger. However the penis was extrudable by applying digital pressure on both sides of the cloaca while bending the animal's tail upwards (plate I).

Mugger (*C. palustris*) of under 80 cm are difficult to sex. The cloacal opening is small, the clitoris and penal tip are extrudable and look alike. As they grow larger the clitoris is no longer extrudable while the penis grows and continues to be extrudable manually. At 2.5 metres (near breeding size for the male) the penis will extrude approximately 10 cm and is about 3 cm in diameter.

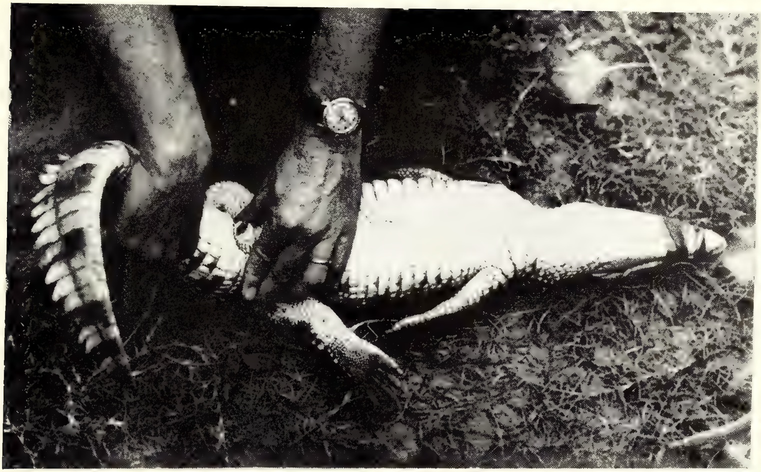
Crocodylus porosus is similar in structure and development rate to the mugger. Animals of 90 cm can be reliably sexed using the fifth finger (small opening).

There is little in the literature on sexing *Gavialis gangeticus*. Our experience in examing 20 *Gavialis* from 1 m (2 years) to nearly 3 m (20 years) suggest that this animal has a slower rate of sexual development than the other two Indian crocodilians. In none of the gharial checked was the penis more than a few centimetres in length though the 2.7 m specimen was over 12 years of age (plates). Captivity (diet, metabolism, enclosure, disturbance) places some developmental limits but one captive male (Nandankanan, Orissa) of about 2.5 m is reported to be developed "normally" by other known crocodilian standards (H. R. Bustard, *pers. comm.*). The specimen is not particularly old (12-15 years) but has a well-developed "ghara" over its nostrils (plate). The ghara is interpreted to be a dimorphic male character (Martin and Bellairs 1977) and may indicate sexual maturity.

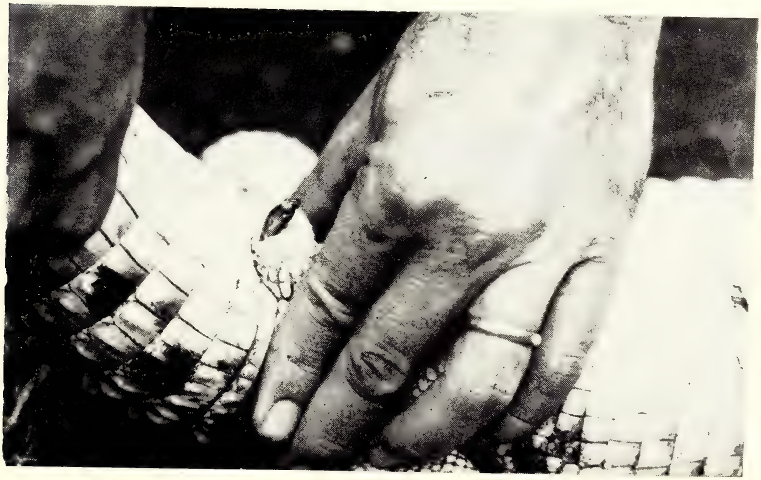
At the Crocodile Bank we have 6 gharial ranging from two 1.2 metres 2 year old to a 2.7 m, 18 year old male. After the February 1978 IUCN/SSC Crocodile Specialist Group Meeting, several of the specialists worked with us checking the lower size limit for sexing young mugger and sexing the gharial. In discussion it was felt that the non-breeding of this crocodilian in captivity is at least partly due to the difficulty in sexing them. The Table gives the basic details of the *Gavialis* checked.

	Year	Approx. Age	Place	Size	Sex	Notes
1.	1974	10	Mysore Zoo	2.8m	♂	No ghara, penis small, distinguishable.
2.	1974	10	Mysore Zoo	2.7m	♀	Smooth cloacal wall with small clitoris
3.	1974	3	Mysore Zoo	1.2m	♀?	At this size sex probably not determinable
4.	1975	2	Madras Crocodile Bank	1.2m	♂?	In 1975 it was sexed as a female; in 1978 (at 2 m) it is apparently a male!
5.	1975	3	Madras Crocodile Bank	1.6m	♂	Penis small but distinguishable.
6.	1977	10+	Ahmedabad Zoo	2.5m	♂	Thought to be a female and penis not detected at first check. Upon rechecking confirmed to be a male (at 2.7 m).
7.	1977	20+	Calcutta Zoo	2.5m	♀	Smooth, wide cloaca with small clitoris about six cm inside on anterior wall.
8.	1977	2	Madras Crocodile Bank	1.1m	♀?	At this size sex probably not determinable.
9.	1977	2	Madras Crocodile Bank	1.2m	?	Sex not determinable.
10.	1978	7+	Patna Zoo	2.3m	♂	No ghara, penis small but distinguishable.
11 to 20.	1978	2, 3	Gharial Project, Kukkrail, Uttar Pradesh	1–1.6m	?	Cloacal opening small and sexes undistinguishable.

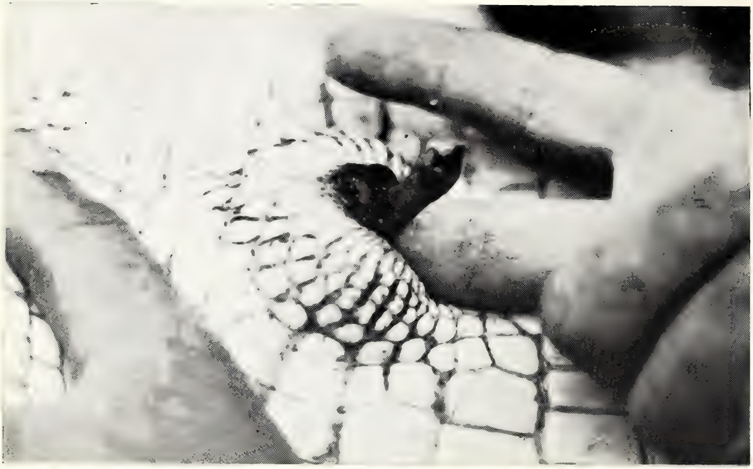
Discussion: If further studies on sexing gharial confirm the difficulties mentioned above, other methods of sex determination must be investigated. Bellairs (THE LIFE OF REPTILES, 1969) mentions that karotyping may not work in crocodilians (*Gavialis?*) but other sex characters may come to light. This problem attains more importance considering that recent research indicates that egg incubation temperature influences the sex ratio of crocodilian offspring and the need in release programmes to stock a suitable ratio.



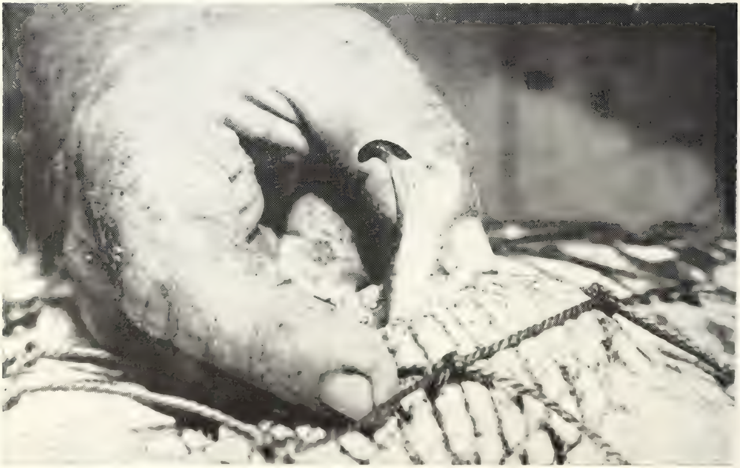
Demonstrating the technique of sexing a juvenile *C. palustris* of 80 cm by tail bending and pressure on sides of cloaca.



Close up of extruded penis of *C. palustris*.



Close up of extruded penis of 2 m *Gavialis.*



Close up of extruded penis of 2.7 m *Gavialis.*

MADRAS CROCODILE BANK TRUST,
VADANEMMELI VILLAGE,
TAMIL NADU,
January 25, 1979.

ROMULUS WHITAKER
ZAHIDA WHITAKER
ALLEN VAUGHAN

REFERENCES

BELLAIRS, A. D'A. (1969): The Life of Reptiles. Weidenfeld and Nicholson.

BRAZAITIS, P. J. (1968): The Determination of Sex in Living Crocodilians. *British Journal of Herpetology.*

MARTIN, B. G. H. & BELLAIRS, A. D'A. (1977): The narial excrescence and pterygoid bulla of the gharial, *Gavialis gangeticus. J. Zool. London 182*: 541-558.

WHITAKER, R. (1975): A note on Crocodilian Sex Determination. *J. Bombay nat. Hist. Soc. 73* (3): 531-532.

19. ON THE OCCURRENCE OF BIFURCATED TAILED IN AGAMA LIZARD FROM SIMLA HILLS, HIMACHAL PRADESH

During September 1970, while undertaking a general faunistic survey of Rajgarh and its vicinity of district Sirmour, H.P., we observed a good number of agama lizards basking on barren rocks, creeping out from below stones and crevices of boulders, of which a few lizards were collected.

While studying these specimens, one lizard was noted to have its tail bifurcated last one-third of the total length of the tail. The specimen was identified as *Agama tuberculata* Gray.

Material: 1 ex. Loc. Rajgarh, Dist. Sirmour, H.P., 3-9-70, M. Chandra.

Measurement: 250 mm. Total length. 123 mm. Standard length.

We are deeply indebted to Dr. R. Bielowski, Institute of Zoology, Polish Academy of Science, Warsaw for his valuable comments and confirmation during his study of Solan in 1973. Thanks are due to the Director, Z.S.I. for the facilities afforded.

HIGH ALTITUDE ZOOLOGY FIELD STATION,
ZOOLOGICAL SURVEY OF INDIA,
SOLAN (H.P.),
December 21, 1978.

MAHESH CHANDRA
RATHIN MUKHERJEE

20. RECENT RE-DISCOVERY OF THE RARE AGAMID LIZARD *OTOCRYPTIS BEDDOMII*

Recently I picked up a juvenile agamid lizard from a bush near a stream in the upper shola, Kodaikanal (2100 m), Palnis, Western Ghats, South India. On detailed examination later the specimen was recognised easily as *Otocryptis beddomii* Boulenger because of its subdermal tympanum and the short fifth toe. Boulenger (1885: 272) has described this species based on five specimens—two females and three juveniles—collected by Colonel Beddome at Sivagiri Ghat, Cardamom Hills, South India. Smith (1935: 148) says: "Ferguson obtained two more specimens in Travancore".

The specimen has the following characteristics: snout-vent length—35 mm; tail—73 mm. Its coloration is as follows: Dorsum with five black transverse bars. While the dark bars on the limbs are clearly visible, the forehead is devoid of the dark bar observed by Smith. No traces of gular appendage.

The specimen bearing Register Number L. 151 is deposited in the reptile collections of the Southern Regional Station of the Zoological Survey of India, Madras 600 028.

The present record of this species from Palanis other than its type locality and nearly after a century since its description is rather interesting. We can definitely say that it is not as rare as to be restricted to the Cardamom Hills, Kerala. However, its definitive distribution should await further exploration of the Western Ghats.

I am thankful to the Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras for facilities.

ZOOLOGICAL SURVEY OF INDIA,
MADRAS-600 028,
June 23, 1980.

T. S. N. MURTHY

REFERENCES

BOULENGER, G. A. (1885): Catalogue of the Lizards in the British Museum (Natural History), Vol. I, 436 pp.

SMITH, M. A. (1935): Fauna of British India. Reptilia and Amphibia, Vol. 2, Sauria.

21. GROWTH RATE OF INDIAN PYTHON, *PYTHON MOLURUS MOLURUS* (SERPENTES: BOIDAE) IN CAPTIVITY WITH SPECIAL REFERENCE TO AGE AT FIRST EGG-LAYING

(*With two text-figures*)

The growth rate of Indian Python from the time of hatching to the age at first egg-laying has rarely been reported. Acharjyo and Misra (1976) reported on the mating, gestation period, egg-laying, incubation, behaviour of the brooding female, hatchlings and quarterly growth rate to the age of one year of Indian Python observed at Nandankanan Biological Park, Orissa, India. They have also stated that it was intended to rear a batch of these hatchlings to sexual maturity. This communication is a follow up to these earlier observations. In this, studies on the quarterly growth rate of 4 to 9 hatchlings of Indian Pythons from the 12th month to the age of the first egg-laying and beyond observed in the same park are reported.

Growth Rate: The quarterly growth rate of 11 to 38 Indian Python babies from the time of hatching to one year old has already been reported by Acharjyo and Misra (loc. cit.).

Our further observations on growth rate from the 12th month to the age of 51st month are as follows (Table 1, Figs. 1 & 2).

TABLE 1

QUARTERLY GROWTH RATE OF YOUNG INDIAN PYTHONS FROM 12TH MONTH TO THE AGE OF 51ST MONTH

Dates	Age in months	Sample size	Mean length (Range) cm	Mean weight (Range) g
1	2	3	4	5
4 July 1975	12	11	136.41 (126.5–153)	942.91 (720–1535)
25 Sept. 1975	15	9	142.72 (127-142)	1251 (780-2330)
25 Dec. 1975	18	6	144.83 (128–179.5)	1152 (635–2170)
25 March 1976	21	5	167.60 (151–194)	1813 (1210–3005)
25 June 1976	24	5	215.50 (190-237)	4755 (2390–6640)
25 Sept. 1976	27	4	215.80 (194–240)	4378 (2250–6110)
25 Dec. 1976	30	4	218.25 (194–240)	4378 (2250–6110)
25 March 1977	33	4	219.75 (195–241)	5551 (3220–7535)
25 June 1977	36	4	233.25 (214–249)	7945 (6580–8540)
25 Sept. 1977	39	4	241.00 (220–257)	8444 (7250–8910)
25 Dec. 1977	42	4	245.75 (233–261)	8408 (7440–8870)
25 March 1978	45	4	246.75 (235–262)	9090 (7750–10,600)
27 June 1978	48	4	248.75 (235–266)	8523 (5570–10,970)
25 Sept. 1978	51	4	250.25 (236–267)	9565 (7430–10,940)

Examination of this table and the graphs reveals that the average growth rate in total length in the first year was maximum (75.70 cm) and the growth rate during the second year (44.99 cm) and third year (51.85 cm) remained almost the same. But during the fourth year the average growth rate was much reduced (15.50 cm).

The weight increase graph (Fig. 2) reveals that the maximum average growth in weight (5115 grams) was recorded during the third year of life and the minimum average growth in weight (578 grams) was recorded in the fourth year.

Two of the (female) pythons first laid eggs in the fourth year and as usual starved for about two months during incubation.

Age at first egg-laying: Two female pythons hatched in the Park during the period from 23 to 25 June 1974 (whose matings were not observed) laid eggs on 27 April 1978 and 4 May 1978 respectively at the age of 3 years

10 months and 3-5 days and 3 years 10 months and 10-12 days respectively. Taking the gestation period as 82-83 days (Acharjyo and Misra, loc. cit.) the age of sexual maturity in these two cases can be said to be about 3 years and 7½ months.

The two females weighed 7.750 Kg (Total length 235 cm) and 8.920 Kg (Total length 250 cm) on 25 March 1978 before egg laying. These two weighed 5.570 Kg (Total length 235 cm) and 6.880 Kg (Total length 251 cm) on 27 June 1978 after the incubation was over.

The two male pythons weighed 9.090 Kg (Total length 262 cm) and 10.600 Kg (Total length 240 cm) on 25 March 1978. They weighed 10.970 Kg (Total length 266 cm) and 10.670 Kg (Total length 243 cm) on 27 June 1978. Since no mating was observed and since all the eggs were found infertile and spoiled, it is presumed that the male pythons require a longer time to reach sexual maturity than females.

Clutch size and eggs: The clutch size of one female which laid eggs on 27 April 1978 was 13 (eight normal sized white coloured eggs and five small sized light brown coloured eggs) whereas the clutch size of the other female which laid eggs on 4 May 1978 was 17 (two normal sized white coloured eggs and fifteen small sized light brown coloured eggs).

Five white coloured eggs measured 8.5-12.0 × 4.7-5.2 cm and weighed 165-207 grams. Five light brown coloured eggs measured 7.4-9.6 × 3.9-5.0 cm and weighed 73.97 g.

DISCUSSION

Deoras (1965) states that in the laboratory an Indian Python of unknown age and unstated size and weight grew 6-8 inches (15-20 cm).

Pope (1962) states that the Indian Python holds the record growth rate of 3½ feet per year for the first two years of life. Our observations partly agrees with his observations in that maximum average growth rate in total length (75.70 cm) was recorded in the first year of life but was less than recorded by Pope (loc. cit.). This partly reflects the natural conditions under which pythons are kept with a marked winter period during which feeding was greatly reduced.

About this species Smith (1943) states that "the rate of growth in nature is not known, and the records of growth in captivity vary so greatly that they are obviously influenced by the conditions under which the snakes live". According to Grzimek (1975) the boids grow fairly quickly until they are 2-3 metres long, but after that time, growth proceeds at a much slower rate. Eight hatchlings of this species grew from an average length of 19¾ inches to 6 feet 7 inches in twenty months, a fourfold increase (Pope, loc. cit.).

Fig. 1 shows the effect of the cooler weather (monsoon quarter) on growth in length. In the year one ,growth was slow in the winter quarter (October-December), picked up in the next quarter (January-March) and was maximum in summer (April-June).

The following comments on the Orissa climate are essential for proper understanding of the discussion. First quarter (January-March) winter gives way to a very brief spring followed by warm weather during February; second quarter (April-June) hot (very hot) season; third quarter (July-September) monsoon season (cooler); fourth quarter (October-December) autumn and winter, feeding much reduced.

In the second year there was marked reduction in growth in the monsoon and winter quarters and rapid growth thereafter which was marked in the monsoon quarter of the

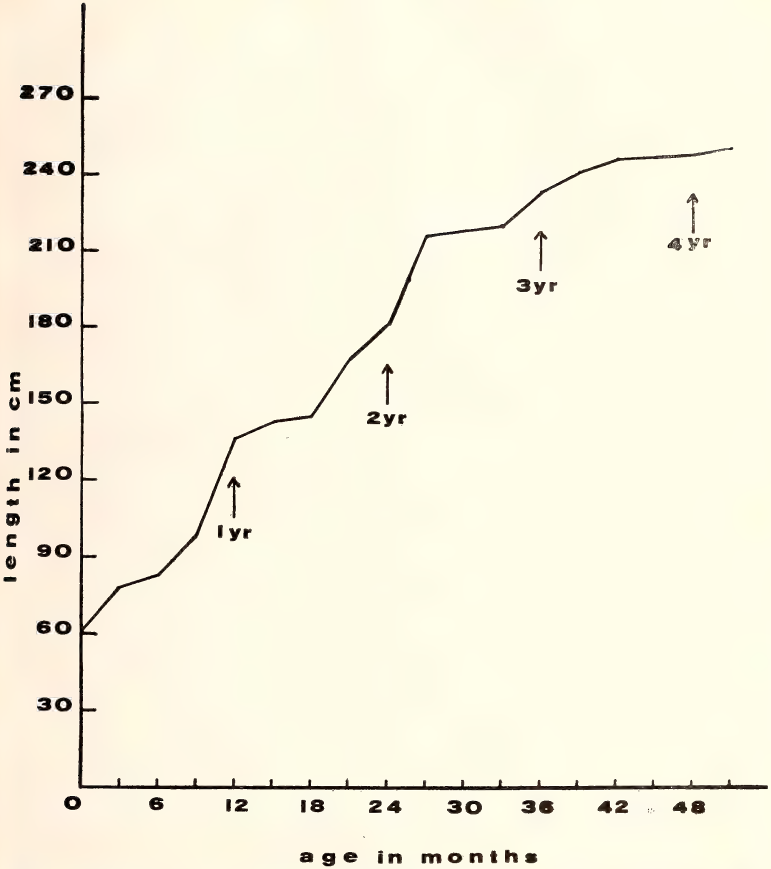


Fig. 1. Graph showing quarterly average growth rate in total length of Indian Pythons from the time of hatching to the age of 51 months (4 years and 3 months).

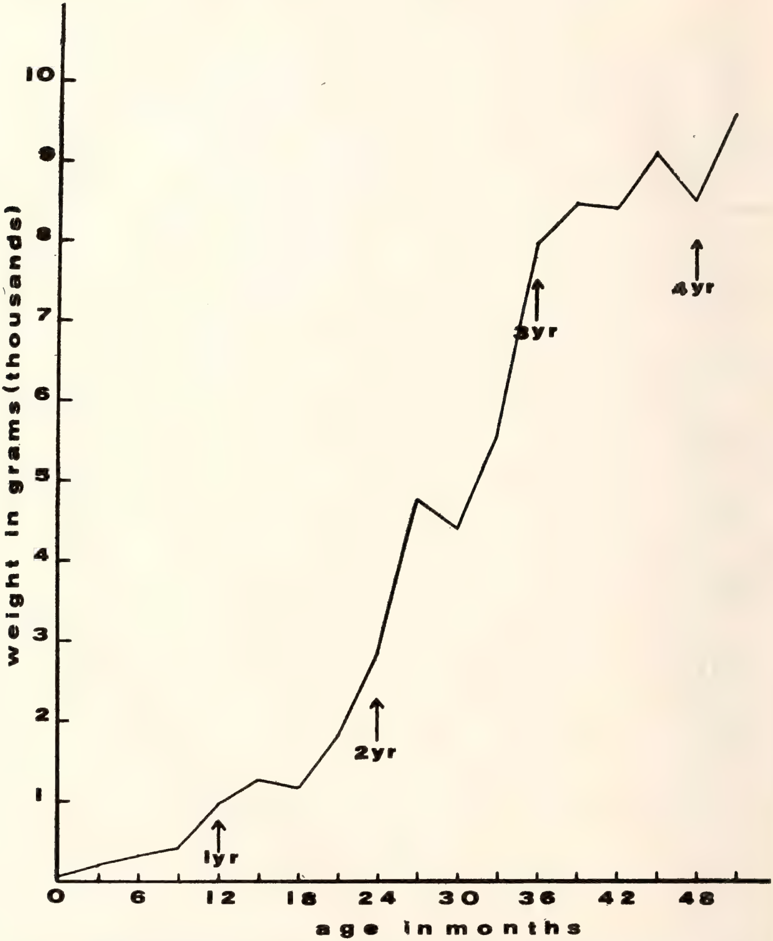


Fig. 2. Graph showing quarterly average growth rate in weight of Indian pythons from the time of hatching to the age of 51 months (4 years and 3 months).

third year. After this, growth slowed down as is to be expected with attainment of sexual maturity.

Fig. 2 shows these effect also and makes interesting comparison with Fig. 1. Marked increase in weight commenced in the third quarter of the second year at eighteen months of age and continued until the age of three years (36 months) with the sole exception of the fourth quarter (October-December) of 1976, when actual loss of weight was recorded due to cessation of feeding. Weight increase was minimum in the fourth year. This partly reflects brooding by the females but also marked reduction in growth following attainment of sexual maturity. There was a good weight increase in the third quarter of 1978 but this reflects more regaining weight lost during the fasting incubation period.

The rapid increase in length was over by 27th month of age, having commenced at sixth month, thus covering 21 months. The rapid weight increase was over at 36th month, having commenced at 18th month and thus occupying 18 months. Hence growth in length was followed subsequently by weight increase which took more time to catch up. The idea of Williamson (1967) that about half of the total length may be attained in the first 3 to 4 years of life is extremely interesting. This hypothesis receives some confirmation from Bustard's finding in the Green Sea Turtle, *Chelonia mydas* (Bustard 1972). To put this more concisely this means the maximum size of the indvidual depends upon early growth, the rate of which is clearly dependent upon genetic and environmental factors (Bustard, Singh and Choudhury, MS) as observed in Indian Mugger Crocodile (*Crocodylus palustris*).

It is clear that much faster growth rates than here reported could have been achieved by winter heating resulting in greatly enhanced feeding during the winter quarters. Such growth rates would however have been much faster than occurs in nature as occurring in the Indian Crocodile (Bustard, Pers. Comm.).

Our own figures are considered to be more closely approximates natural growth being recorded out-doors under ambient temperature conditions within the natural range of the species. However they may exceed wild growth as a result of enhanced food supply. This in itself may have resulted in first egg laying at an early age than is naturally the case in nature (Bustard, Pers. Comm.).

The boids reach sexual maturity in three years in captivity (Grzimek, loc. cit.). According to Pope (loc. cit.) the smallest Indian python to produce fertile eggs was only 8 feet 6 inches (2.55 m). He further states that the female of a mated captive pair of this species laid fertile eggs at the age of less than three years.

SUMMARY

The quarterly growth rate of 4 to 11 Indian pythons from the 12th month to the age of 51st month were observed in a natural environment at Nandankanan Biological Park, Orissa, India.

The average growth rate in total length in the first year was maximum (75.70 cm) and the growth rate during the second year (44.99 cm) and third year (51.85 cm) remained almost the same. But during the fourth year growth rate was much reduced (15.50 cm). The maximum average growth in weight (5115 g) was recorded during the third year of life and the minimum average growth in weight (578 g) was recorded in the fourth year.

ACKNOWLEDGEMENT

We are grateful to Dr. H. R. Bustard, F.A.O./U.N.D.P. Consultant on Crocodiles in India for his help in the preparation of this paper.

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WILD LIFE CONSERVATION OFFICER,
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ORISSA (INDIA),
April 21, 1980.

CH. G. MISHRA

REFERENCES

ACHARJYO, L. N. AND MISRA, R. (1976): Aspects of Reproduction and Growth of the Indian Python, *Python molurus molurus,* in captivity. *British Journal of Herpetology, 5*: 562-65.

BUSTARD, H. R. (1972): Sea-Turtles: Their Natural History and Conservation. Collins, London & Sydney.

———— SINGH, L. A. K. AND CHOUDHURY, B. C. (M.S.): Growth of Three Populations of Mugger Crocodiles, *Crocodylus palustris* Lesson (Reptilia, Crocodilia) from Tamilnadu, South India, M.S.

DEORAS, P. J. (1965): Snakes of India. National Book Trust, India, New Delhi.

GRZIMEK, BERNHARD (1975): Animal Life Encyclopedia, Vol. 6, Reptiles, Van Nostrand Reinhold Company, New York, Cincinnati, Toronto, London, Melbourne, pp. 363-380.

POPE, CLIEFORD H. (1962): The Giant Snakes. Routledge & Kegan Paul, London.

SMITH, M. A. (1943): The Fauna of British India, Reptilia and Amphibia. Vol. III, Serpentes, Taylor & Francis, London, pp. 102-110.

WILLIAMSON, MICHAEL A. (1967): Notes on the Growth Rate of *Python reticulatus* (Serpentes: Boidae). *Herpetologica,* Vol. 23, No. 2, pp. 130-132.

22. COBRA AND LITTLE BITTERN *IXOBRYCHUS MINUTUS*

On the morning of 5th August I had the opportunity to collect a cobra (*Naja naja oxiana*) lying dead on the bank of river Tawi (360 m), with a little bittern stuck in its throat. Examination confirmed that the snake had died in the struggle to swallow the little bittern (*Ixobrychus minutus*) which was comparatively large in size and there were no bruises or even scratches on the body of the snake.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF KUMAUN,
NAINITAL, (U.P.),
September 18, 1978.

B. D. SHARMA

23. *KHULNAWA*—A SPECIAL FISHING DEVICE FOR MINNOWS IN THE RIVER GANGA AT PATNA (BIHAR)

(*With a plate*)

Break-up figures of fish landings from the river Ganga at Patna during the years 1958 to 1966 indicate the larger groups, comprising *Cirrhinus mrigala, Catla catla, Labeo rohita, Mystus aor, M. seenghala, Wallago attu* and *Hilsa ilisha,* constitute over 55% of the total fish landing (Jhingran *et al.* 1970). From our visits to fishing sites in the river at Patna and also from emphatic comments of the fishermen we gathered that there has been a sharp decline in the catch of the larger groups of fishes in this stretch of the river with *Hilsa ilisha* on the verge of disappearance. Increasing dependance of the local wholesale fish market (Mussallepur Haat) on the imports to the extend of over 60% from other states for the larger fishes is yet another evidence of fall in the catch in the river. The fishermen recall noticing the declining trend with coming up of the Farrakka barrage across the Ganga in the Malda district of West Bengal. While obstructional role of the barrage on the migration of *Hilsa ilisha* is as per expectations, cause of the fall in catch of the other larger fishes is incomprehensible beyond the point that their number might have thinned out in this stretch of the river due to some unobserved subtle ecological changes associated with the installation of physical structures in the river. Naturally, the fishing community dependent on the river Ganga along Patna are obliged to adopt the gears suitable for exploiting the smaller group of fishes whose catch is relatively assured. During the course of a survey of these newly adopted fishing practices, an ingenious device for catching minnows was noticed with quite a large concentration of the same at Ghaggha Ghat in the Patna Sahib area. The antecedent, structure and operation of the gear-craft were studied by visiting the fishing sites and interviewing the fishermen. The findings are presented in this note.

Nomenclature and history: The device is locally called *Khulnawa* which means an open wale boat. It has been introduced here from the Tarai region of Nepal only a decade ago but now with its proven efficacy to fetch a good catch of minnows, already there are one hundred and odd of the gear-craft operating in the 30 km stretch of the river along Patna. Obviously, the gear-craft does not find mention in any of the earlier descriptions of the fishing methods in the Ganga river system (Hornell 1923, Farupui and Sahai 1943, Anonymous 1949, Job and Pantulu 1953, and Saxena 1966).

Structure: The device (see Plate) has three components namely (1) the boat with one of the wales open (2) a screen platform and (3) a frilled pole.

The boat; It is an ordinary plank built narrow keel-less dinghy with equipointed bow and stern. It is about 7.5 m long and about 65 cm broad at the middle with a shallow depth of merely 25 cm. The wale on one side has a cut out opening, about 5 m long and 12 cm deep. Kathal (*Artocarpus integriofolia*) or Sal (*Shorea robusta*) wood are used in construction of the boat. The boat is kept pitch dark in colour by regular coatings of coal-tar.

The screen platform: It is a closely knit screen of bamboo splinters measuring about 5 m by 0.5 m. To construct it, 40 and odd number of fine flat strips of bamboo are woven by interlacing them with 5 rows of plastic cords. For reinforcement, the screen is supported by broader splinters of bamboo 70 cm long at intervals of about 50 cm. The extra length of the splinters over the width of the screen project inwards where it is attached to the boat and provide room for fastening with strings to pegs fixed on the floor of the boat. Fixed at the cut portion of the open wale, the screen slopes out so that its free margin is constantly immersed in the water. The screen is always maintained in sparkling white condition by coatings of enamel paint.

The frilled pole: It comprises of one full length piece of 4 to 6 m long bamboo pole with tufts of dry *Save* grass (*Pollinidium anguistifolium*) drooping as frill along $\frac{3}{4}$th of its length. To make the outfit, a tuft of 4 to 6 dry blades of the grass is tied to the narrower end of the pole, then while half the length of the tuft is twisted into string, the other half is left loose. The next tuft is tied to the portion of the first tuft and likewise initial half of it is twisted into string and the remaining part droops as frill. Series of the tufts of the grass are wrought in the fashion to make a drooping frill along the desired length of the pole and the last tuft is twisted into string and fastened to the pole. The whole frill remains hanging from the pole by the tying of it at intervals of about 50 to 60 cm.

Operation: *Khulnawa* is operated by two men, keeping the boat always parallel to the bank of the river at a distance little more than the frilled pole. The side of the boat with open wale and the screen faces the bank. The man sitting at the stern rows the boat and manoeuvres the frilled pole while the other one sitting at the bow helps in rowing and attends to the catching operation. The manoeuvring of the frilled pole is so done as to keep the free edge of the drooping grass just overhanging the surface of the water. Surface inhabiting minnows that happen to be schooling in between the boat and the bank are scare-driven towards the boat by the looming shadow of the frilled pole. In the dark, the bright white screen jutting down to the water from the cut wale, possibly, gives the fishes an illusion of flowing stream and in their attempt to negotiate it, they leap into the boat-hold.

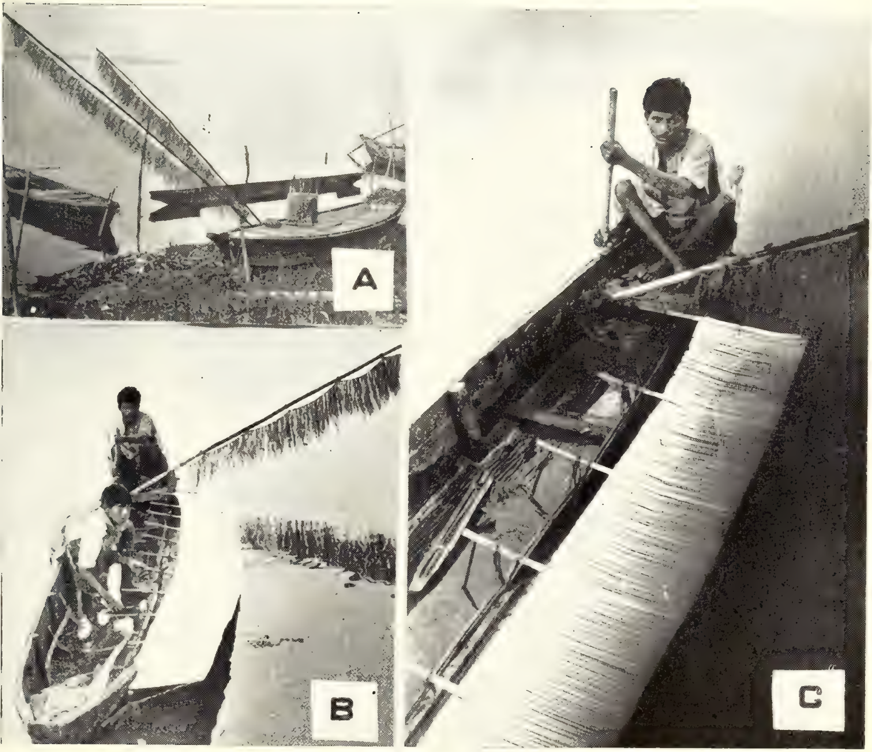
Khulnawa's catch efficacy is confined to night time with better results in moonless nights having calm weather. Possibly, such conditions favour the illusionary effect. The best operation period in a year has been experienced as February to April, obviously owing to favourable ecological condition of the water like higher transparency and plankton growth leading to surface foraging by the fishes.

When *Khulnawa* is taken out for fishing, it is operated intermittently althrough the night covering a distance of 5 to 10 km from the point of sail. The catch during a single night varies from 15 to 50 kg with the high figures restricted between middle of March to end of April. The species featuring in order of abundance are *Oxygaster bacaila*, *Gadusia chapra*, *Setipinna phasa*, *Aspidoparia morar* and smaller species of *Puntius*. Major or medium carps or catfishes are rarely caught.

Khulnawa seems to be a fishing device worth trying in lakes, reservoirs and other rivers with favourable ecology.

ACKNOWLEDGEMENTS

We are thankful to Dr. P. S. Prasad, Director of Fisheries, Bihar and Shri T. K. Chakravarty, District Fisheries Officer, Patna for their cooperation.



(A) The components of *Khulnawa* when not in operation. Note the screen platform kept in rolled condition on the boat aground, the two frilled poles kept tucked on the same boat, and the *dinghy* in full view in water. (B) The components of *Khulnawa* being set together for a fishing round. (C) A close-up view of the screen platform fixed up in the boat for start of operation.

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February 14, 1979.

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REFERENCES

ANONYMOUS (1949): Preliminary guide to Indian fish, fisheries, methods of fishing and curing. Manager of Publications, Delhi: 137 pp (Marketing Series, 66).

FARUQUI, A. J. AND SAHAI, R. (1943): Methods of catching fish in the United Provinces and the scope of establishing inland fisheries in these provinces. *Proc. Nat. Acad. Sci. 13* (B): 198-214.

HORNELL, J. (1923): The fishing methods of the Ganges. *Mem. Asiat. Soc. Bengal 8*(3): 199-237.

JHINGRAN, V. G. *et al.* (1970): Fisheries of the Ganga river system (MS) crossed referred to from 'Fish and Fisheries of India' by V. G. Jhingran, Hindustan Publishing Corporation, New Delhi (1975).

SAXENA, R. K. (1966): The fishing nets and traps in a section of the middle reaches of Ganga river system of India. *Pro. Indo-Pacif. Fish. Coun. 11* (2): 250-271.

24. A NOTE ON THE DRAGONFLIES (ODONATA: INSECTA)

In October, 1976 we saw a specimen of *Orthetrum sabina sabina* (Drury) flying above the water in a small weedy pond in Sibpur Botanical Garden, Howrah district, West Bengal (India). After flying for sometime, it sat on the vegetation in the pond. Some *Acisoma panorpoides panorpoides* were also circling over the water and then resting on the aquatic vegetation. The *Orthetrum sabina sabina* suddenly caught by the thorax an *Acisoma panorpoides panoropoides* with its legs and sat on the small grass stalk and chewed it slowly till it was fully consumed.

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CALCUTTA 700 012,
February 4, 1978.

MAHABIR PRASAD
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25. *MICROTROMBIDIUM* SP.—AN ACARINE ECTOPARASITE OF *MUSCA DOMESTICA NEBULO* FABR.

Recently at Saharanpur (U.P.) the common house fly, *Musca domestica nebulo* Fabr., was observed infected by the larvae of *Microtrombidium* (Trombididae, Acarina). This is the first record of an ectoparasite on this house fly.

During May to August, 1976 and 1977, a good number of house flies were collected from different localities and examined for infection by larvae of *Microtrombidium*. During 1976, 12.70 to 14.10 per cent of (average being 13.4 per cent) were infected by the acarine. Similar trend was noticed during 1977 also and the infection ranged from 11.80 to 13.70 per cent, average being 13.00 per cent. The ectoparasite was found attached in general, on almost all parts of the host fly, namely wings, head, mouth parts, thorax, abdomen and legs, the maximum individuals occurring at wing articulation and on the mouth parts. These suck the body fluid of the host fly and severely infected flies fail to feed and fly, become weak and finally die.

The larva of *Microtrombidium* is about 0.43 mm long and 0.19 mm wide with the colour of the body being red. Two blackish dots are visible externally, one each on the thorax and the abdomen. On the thorax, blunt small spines are present. The body and appendages are densely clothed by fine spines. Laterally, on the dorsal surface of the body, polygonal areas are present.

Transmission of this ectoparasite takes place during the process of mating. Often the larvae are shed off in the debris from the host body from where they stick on to the body of visiting house flies.

ACKNOWLEDGEMENTS

We are grateful to the Director, Common Wealth Institute of Entomology, British Museum (Natural History), London for identifying the ectoparasite. The help of Prof. V. C. Chatterjee in the preparation of this note is gratefully acknowledged. We are also thankful to Dr. G. D. Garg for his encouragement.

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SAHARANPUR (U.P.),
April 26, 1978.

26. A SUPERNUMERARY LARVAL INSTAR AND ANTIMELANIN EFFECT ON THE 6TH INSTAR LARVAE OF *SPODOPTERA LITURA* (F.) (LEPIDOPTERA: NOCTUIDAE) BY ALTOZAR—A JUVENILE HORMONE ANALOGUE

A number of analogues of the juvenile hormone have been obtained and tested against several species of insects to inhibit the adult growth and reproduction. Altozar is one of these analogues. In the present note observations carried out with Altozar against *Spodoptera litura,* a serious lepidopterous pest of several crops for its juvenile effect are reported.

Newly moulted 6th instar larvae of *S. litura* were obtained from a stock culture maintained in breeding jars at 27± 1°C and 70-80% R.H. Separate strips of filter paper each measuring 3.0 × 3.0 cm were soaked in 0.25 ml acetone solution containing 0.25 mg, 0.50 mg and 1.00 mg Altozar (Ethyl 3, 7, 11-trimethyl-(2E, 4E)—2, 4-dodecadieonate), a juvenile hormone analogue (supplied by Zoecon Corp., Palo Alto, California, U.S.A.) and dried. On each paper strip, treated with the respective concentration, a group of three larvae of *S. litura,* newly moulted from the 5th instar were released to remain in contact with the treated paper for two days. A total of 78 larvae were treated with each concentration. Strips soaked in acetone alone served as control. These larvae were daily provided with fresh castor leaves as their food.

All the larvae kept in contact with the treated strips with the respective concentration of Altozar developed red pigmentation on the cuticle instead of normal dark black pigmentation within 24 hrs. Further, the larvae contacting 0.50 mg and 1.00 mg concentrations of Altozar had longer (5-6 days) duration of this instar than that of the control which had 3-4 days duration of the 6th instar.

Out of the larvae in contact with 0.50 mg concentration, 5.0 per cent unsuccessfully tried to moult to a supernumerary larval instar. Such larvae developed a new cuticle below the larval cuticle of the 6th instar but the older cuticle could not be cast off completely inspite of the repeated trial by the larvae and they died after 3-4 days. In case of the larvae kept in contact with 1.00 mg concentration, 6.25 per cent larvae died in their unsuccessful attempt to moult to a supernumerary instar, but 13.33 per cent of these larvae successfully moulted to a supernumerary instar which also had red pigmentation.

The larvae when they successfully entered the supernumerary larval instar had an average duration of two days and their average length and width were 4.860 cm and 0.658 cm respectively as compared to 4.12 and 0.50 cm of the normal 6th instar larvae. The supernumerary larvae were also heavier (0.939 g) as compared to the normal 6th instar larvae (0.616 g average). In other morphological respects supernumerary larvae were like those of the 6th instar. However, all the supernumerary larvae died during the larval-pupal moult.

Melanin pigments are generally incorporated in the substance of the cuticle, they range in colour from yellow to black. Tyrosine (Monoxy-phenyl alanine) is oxidized in the presence of the enzyme Tyrosinase (Cordier 1928). At least three compounds are recognized in the tyrosinase complex: monophenolase converting tyrosine to 'dopa' or 3-4-dioxy- phenylalanine; diphenolase, a copper protein compound converting 'dopa' to red substance, hallachrome; and enzyme III, apparently a dehydrase which converts hallachrome to a colourless substance and then to melanin (Danneel 1946). In *S. litura,* it appears that Altozar inhibits enzyme III so that hallachrome did not convert into melanin and remained to give red coloration of the cuticle. However, in *Blatella germanica,* Altozar increased level of melanization in supernumerary nymphs and adultoids (Riddiford *et al.* 1975).

In *S. litura,* the duration of larval period increases probably because of the presence of exogeneously applied juvenile hormone analogue in the last larval stage which delayed the pupal moult. The implantation of active corpora allata results in the production of a supernumerary larva in *Galleria mellonella* (Sehnal 1968). Application of *Cecropia* Juvenile hormone to final instar larvae also have the same effect (Sehnal and Meyer 1968). Thus the formation of a supernumerary larval instar in *S. litura* totally conforms to the fact that the exogeneous application of juvenile hormone analogue to the last instar larva results in the production of a supernumerary larva. However, no significant increase in the number of larval stadia was observed in another lepidopteran, *Porthetria dispar* when its larvae were treated with Altozar (Granett 1974).

ACKNOWLEDGEMENTS

We wish to express our gratitude to Prof. Shah Mashhood Alam, Head of the Department of Zoology, A.M.U., Aligarh, for his encouragement and constructive criticism and to Zoecon Corporation, Palo Alto, California, for the gift of Altozar. The first author also expresses his thanks to the C.S.I.R., New Delhi, for the award of a Research Fellowship during the progress of this work.

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REFERENCES

CORDIER, R. (1928): Melanin pigments. *Ann. Bull. Soc. Roy. Sci. Med. Nat. Bruxelles.*, 43-57.

DANNEEL, R. (1946): Melanin formation: *Drosophila. Biol. Zbl.*, *63*: 377-94.

GRANETT, J. (1974): Juvenile hormone analogue toxicity to laboratory reared gypsy moth larvae, *Porthetria dispar. Can. Entomol.*, *106*: 695-99.

RIDDIFORD, L. M., AJAMI, A. M. AND BOAKE, C. (1975): Effectiveness of insect growth regulators in the control of populations of the german Cockroach. *J. Econ. Entomol.*, *68*: 45-48.

SEHNAL, F. (1968): Influence of the corpus allatum on the development of internal organs in *Galleria mellonella. J. Insect Physiol.*, *14*: 73-85.

SEHNAL, F. AND MEYER, A. S. (1968): Larval-pupal transformation: Control by Juvenile hormone. *Science*, *159*: 981-983.

27. *PTERIS DACTYLINA* HOOK. FROM SILENT VALLEY—A NEW RECORD FOR PENINSULAR INDIA

Beddome (1883, 1892) described twenty six taxa belonging to the genus *Pteris* Linn. (including *Campteria* Presl, p.p.), out of which fifteen are reported by him to be present in Peninsular India. Nair and S. R. Ghosh (1976) described a new species *Pteris furunculata* Nair et S. R. Ghosh from the Western Ghats. Further studies on the ferns of Kerala (Nair and S. R. Ghosh 1977 a, b) enabled them to discover *P. confusa* Walker, *P. gongalensis* Walker, *P. multiaurita* Agardh, *P. praetermissa* Walker and *P. roseo-lilacina* Hieron. from that area. *P. tremula* R. Br. was reported from Shevroy Hills, Salem Dt., Tamil Nadu, by Nair and S. R. Ghosh (1977 c). *P. heteromorpha* Fée and *P. memoralis* Willd. were discovered from Orissa by Nair and R. K. Ghosh (1975, 1978). Bole and D'Almeida (1977) described a new species *P. almeidiana* Bole et D'Almeida from Maharashtra. These new discoveries emphasize the need for more intensive and extensive explorations and herbarium studies with regard to the genus *Pteris* Linn. in Peninsular India particularly in view of the fast disappearing forests from the region and the consequent ecological imbalance setting in. It must also be stressed that several species of *Pteris* Linn. are very sensitive to environmental changes.

The present record of *P. dactylina* Hook. from the dam site in Silent Valley, Kerala is another addition to the fern flora of Peninsular India and it is certainly one among the threatened taxa of ferns from the area in view of the proposed Silent Valley Project. Earlier, this small and delicate plant was known only from Sikkim to Khasia. The present discovery, therefore, is also of phytogeographical significance. Since a detailed description of this species is not available in the literature, it is provided in the present report.

Pteris dactylina Hook. sp. Fil. 2; 160. f. 13A. 1858; Bedd. Ferns Brit. India 23. f. 23. 1866; Handb. Ferns Brit. India 107. fig. 56. 1883.

Terrestrial small herbs; rhizome short, erect or obliquely ascending, scaly at growing tips; stipes variable, 5-25 cm long, stramineous, glabrous; lamina digitate with 3-7 pinnae; pinnae 5-15 cm long, linear, margin sharply serrate towards the sterile apex; veins simple or forked; indusium broad, subintramarginal, membranaceous; sori submarginal, linear; spores brown with light brown perispore.

Specimens examined: Kerala, Palghat District, Panthanthode to Silent Valley Dam site, 900 m, *N. C. Nair* 56637, Acc. No. 103435, 7-4-1978 (MH); Eastern India, Assam, Local Hill, Cherapunji, ± 1200 m, *Gustavmann* 65, Acc. No. 87906, Sept. 1889 (MH).

BOTANICAL SURVEY OF INDIA,
COIMBATORE 641 002,
July 26, 1979.

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REFERENCES

BEDDOME, R. H. (1865): Ferns of British India being the figures and description of ferns of all parts of British India. Gantz Brothers, Madras.

——————— (1883): Handbook to the Ferns of British India, Ceylon and the Malay Peninsula. Thacker Spink and Co., Calcutta.

——————— (1892): Handbook to the ferns of British India, Ceylon and the Malay Peninsula with a supplement, Calcutta (repr. ed. 1969, New Delhi).

BOLE, P. V. AND D'ALMEIDA, M. R. (1977): Four new species of Pteridophytes from Bombay Presidency. *J. Bombay nat. Hist. Soc. 74*: 320-325.

NAIR, N. C. AND GHOSH, R. K. (1975): Notes on some additional distribution of ferns to the botany of Orissa. *J. Indian bot. Soc. 54*: 45-49.

——————— (1978): *Pteris heteromorpha* Fee—A new record for India. *Indian Forester 104*: 374-376.

NAIR, N. C. AND GHOSH, S. R. (1976): A new species of *Pteris* from Western Ghats. *J. Indian bot. Soc. 55*: 38-40.

——————— (1977a): *Pteris quadriaurita* Retz. and a few related taxa in Kerala. *J. Bombay nat. Hist. Soc. 73*: 438-443.

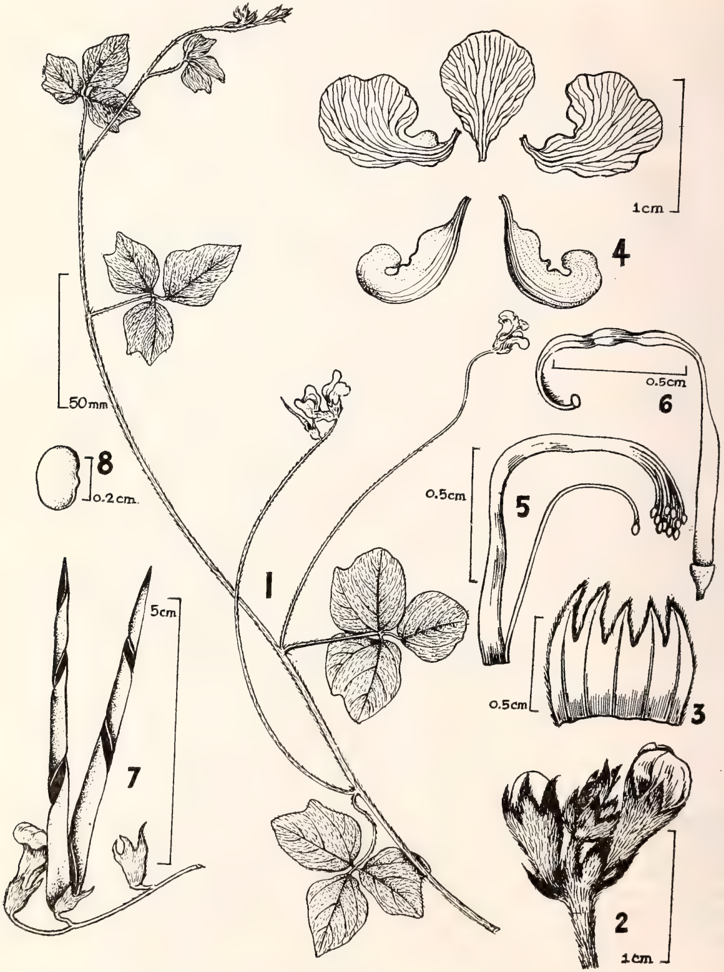
——————— (1977b): *Pteris roseo-lilacin*a Hieron.—A new record for Peninsular India. ibid. *73*: 424-425.

———————(1977c): *Pteris tremula* R. Br.—A new record for India. ibid. *73*: 240-241.

28. THE GENUS *MACROPTILIUM* (BENTH.) URB.—A NEW RECORD FOR INDIA

(*With eight text-figures*)

Macroptilium atropurpureum (DC.) Urb. Symb. Antill 9: 452. 1928. Verdc. in Kew Bull. 24: 517, 1970 (in foot notes). *Phaseolus atropurpureus* DC. Prodr. 2: 395, 1825. Slender creeping herbs; stem terete, obscurely striate, grey tomentose. Leaves alternate, trifoliate; petioles 1-5.2 cm long, tomentose; stipules 2-5 mm long, reflexed, narrowly deltoid, acute, tomentose, more so without. Leaflets ovate, terminal ones sometimes rhomboidal, 1.3-3.5 × 0.7-2.9 cm, lateral leaflets as long as terminal ones and broader, acute, apiculate,


1
2
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4
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6
7
8
1cm
1cm
0.5cm
0.5cm
0.5cm
5cm
50mm
0.2cm.

Figs. 1-8. *Macroptelium atropurpureum* (DC.) Urb.: 1. Part of plant. 2. Young inflorescence 3. Calyx split open. 4. Corolla parts. 5. Androecium. 6. Gynoecium. 7. Pods (dehisced). 8. Seed.

obscurely lobed, round or truncate at base, nerves prominent beneath, grey tomentose above and more so beneath; petiolules 2-5 mm long, tomentose; stipels minute, subulate, tomentose. Flowers in axillary racemes; peduncles 10.5-20.5 cm long, tomentose; bracts and bracteoles minute, tomentose, caducous, Calyx green tomentose, tube nearly as long as lobes; upper 3 lobes shorter than lower 2, narrowly deltoid, acuminate. Corolla purple, upto 1.5 cm long; wing petals deeply coloured, longer than vexillum and keel; vexillum reflexed, keel incurved. Stamens 9 + 1, vexillary stamen free; style incurved at right angle, bearded on the adaxial side below the capitate stigma. Fruits nearly terete, beaked, upto 7 cm long, grey tomentose, valves twisting after dehiscence. Seeds dark brown, upto 3 mm long, more than 1 mm broad.

This is a tropical American species now widely cultivated in parts of Africa (Kenya, Malawi, Zambia, South Africa and Zimbabwe); New South Wales and Queensland in Australia and Hong Kong in Asia. It was found growing in the fodder grass plot of Tamil Nadu Agricultural University, Coimbatore and probably came as an impurity with some other seeds. An allied species, *M. bracteatum* (Nees & Mart.) Verdc. is also found near Waltair in Andhra Pradesh. (Information kindly furnished by Dr. G. Panigrahi from Kew Herbarium.)

The typical characters of the genus *Macroptilium* (Benth.) Urb. are squarish hooked style; wings rounded and longer than vexillum and keel; stipules not produced below the base.

Specimens examined: Farm of Tamil Nadu Agricultural University, Coimbatore, 487 m, 20-8-1974, *Marudan* 39285, in flowers and fruits.

ACKNOWLEDGEMENTS

We are grateful to Dr. G. Panigrahi, Regional Botanist at Kew, for confirming the specimens and supplying the distribution data. We thank Dr. N. C. Nair, Deputy Director, Southern Circle, Botanical Survey of India for his help and encouragement.

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July 25, 1979.

29. ADDITIONS TO THE FLORA OF RAJASTHAN

During the course of identification of plants collected from Bhilwara and Jodhpur districts of Rajasthan, I came across the following species which were not recorded earlier from Rajasthan. All the specimens cited in the paper are deposited in the herbarium of Arid Zone Circle, Botanical Survey of India, Jodhpur (BSJO).

Alysicarpus heterophyllus (Baker) Jafri & Ali, in Biologia 12: 33. 1966; Ali, in Fl. W. Pak. 100. 343. 1977; *A. vaginalis* var. *heterophyllus* Baker, in Hook. f., Fl. Br. Ind. 2: 158. 1879.

An erect or diffuse annual herb upto 45 cm, in moist sandy soil amidst grasses. Stem slightly angular, puberulous. Leaves stipulate, 1-3, foliolate intermixed. Leaflets 0.5-4.5 × 02-1 cm, lanceolate, oblong-lanceolate, acute. Flowers yellowish-pink to bluish pink in distant pairs along a filiform, leaf opposed rachis. Calyx teeth equalling the first joint of pod. Pods 4-6 jointed, compressed, sub-moniliform, reticulately veined. Scarce.

JODHPUR: along Jaisalmer road near Tolesar, *A. N. Singh* 4350.

Flowers & *fruits*: August.

Eleocharis congesta D. Don, Prod. Fl. Nep. 41. 1825; Clarke, in Hook. f., Fl. Br. Ind. 6: 630. 1894.

Erect tufted herb, nearly 10 cm tall, in marshy places. Stem striate. Sheath appressed, purplish at base. Spikelets ovoid, solitary, terminal. Glumes membranous, ovate, lanceolate, 1-nerved. Bristles brown, scabrid. Nuts trigonous. Common.

JODHPUR: Banganga river bed, near Bilara, *A. N. Singh* 3523.

Flowers & *fruits*: February.

Samolus valerandi Linn., Sp. Pl. 171. 1753; Hook. f., Fl. Br. Ind. 3: 506. 1882; Duthie, Fl. Up. Gang. Pl. 2: 7. 1911.

A glabrous annual herb in moist shady places, in rocky soil. Stem erect (rarely horizontal), upto 50 cm tall. Leaves rosulate, spathulate, apiculate at base, alternate spathulate to obovate-elliptic above. Flowers white, in axillary and terminal racemes, pedicelled. Pedicels geniculate at the insertion of a small bract at or above the middle. Calyx tube hemispheric, half adnate to ovary, 5-toothed. Corolla lobes imbricate. Stamens 5, alternating with scaly staminodes. Ovary globose, half inferior. Scarce.

BILWARA: Mandalgarh forests along Bijolia Road, *A. N. Singh* 7164.

Flowers & *fruits*: February.

ACKNOWLEDGEMENTS

I am indebted to the Director, Botanical Survey of India, Howrah and the Deputy Director, Arid Zone Circle, Botanical Survey of India, Jodhpur for encouragement.

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30. NOTE ON THE OCCURRENCE OF *AGROSTIS NERVOSA* NEES EX TRIN. IN WESTERN HIMALAYA

During a collection tour of Rudranath bugyal (an alpine-medow) of District Chamoli (North Garhwal) U.P. an interesting grass was obtained. It was identified as *Agrostis nervosa* Nees ex Trin. syn. *A. Clarkii* Hook. f.

Hook, f.; in Fl. Br. Ind. 7: 257 (1896) mentioned the occurrence of this grass from North Western Himalaya without precise locality.

Bor, N. L. in Kew Bull. (1954) 459-60, states, "This grass is exceedingly common in Sikkim but strangely enough the Type comes from Western Himalaya and is the only gathering from the areas".

Bor (1960) in Grassess Burma, Ceylon, India and Pakistan: 388 does not indicate its occurrence in Western Himalaya.

This note now presents the precise locality of this grass in Western Himalaya, i.e. Rudranath bugyal, alt. 4000 m. District Chamoli (North Garhwal), U.P., where it is gregarious in open grassy hill slopes of alpine pastures.

This grass is relished by sheep and goats.

Specimen examined: Joshi, D. N., 87 (30-8-1976) Rudranath, 4000 m., District Chamoli (North Garhwal), U.P.

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31. ON THE OCCURRENCE OF *CLEOME FELINA* L. f. (CLEOMACEAE) IN MAHARASHTRA

(*With six text-figures*)

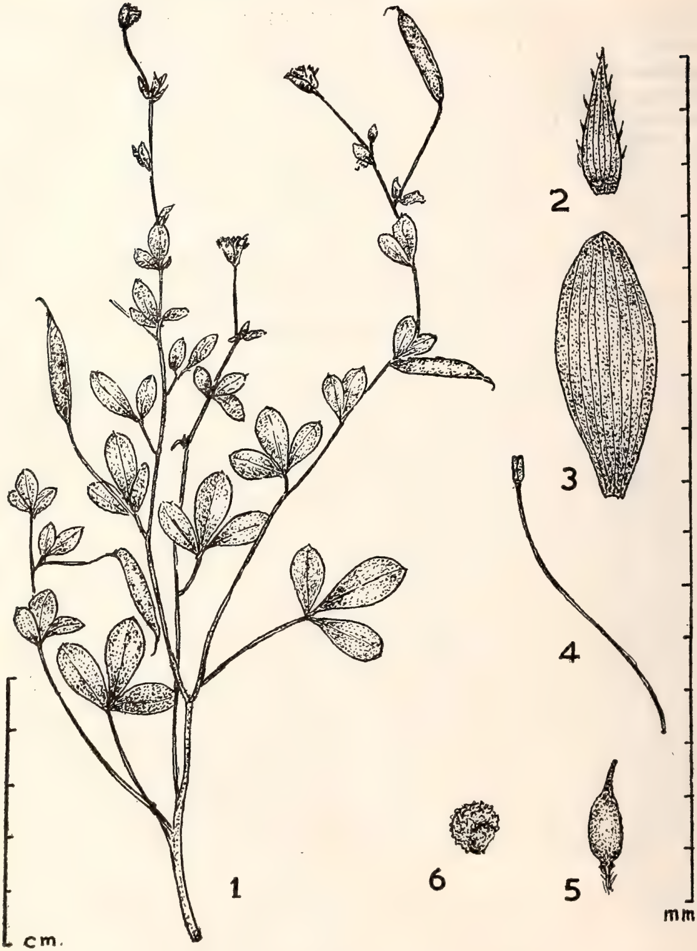
Hooker f. & Thoms. (1872) and Gamble (1916) have recorded the occurrence of *Cleome felina* L. f. from Deccan and Carnatic areas in South India. This species has not been recorded earlier by Cooke (1901-08) or Haines (1916) from areas that fall under Maharashtra State. A critical study of this species collected from Chandrapur district reveals that *Cleome felina* L. f. is often confused with *Cleome chelidonii* L. f. especially in the vegetative condition, though both are easily distinguishable in flowering or fruiting stage. The former is characterised by slender woody root system, densely clothed with bristly hairs all over, small pink flowers and short compressed striate capsules while the latter has got robust fleshy root system, is less hairy, has comparatively large rosy flowers and long slender terete, often constricted, capsules.

The earlier collections (*R. K. Bhide s.n., Rolla S. Rao* 85280; *K. V. Billore* 116179) housed in the herbarium of Western Circle (*BSI*) identified as *Cleome felina* L. f. are in vegetative condition and on scrutiny they are referable to *Cleome chelidonii* L. f. only. The plant collected from Manikgarh hills, Lakkadkote area, Chandrapur district (*Malhotra* 140127) is *Cleome felina* L. f. and is a new record for Maharashtra State extending its distribution further north.

In view of its rarity and absence of any known published illustrations for the plant, a line drawing is provided along with a brief description.

Cleome felina L. f. Suppl. 300. 1781; Hk. f. & Thoms. in Fl. Brit. India 1: 170. 1872; Gamble Fl. Pres. Madras 1 : 41 (29) : 1915.

An appressedly hairy herb. Leaves usually trifoliate, obovate. Flowers small 0.5 cm, corolla pink, bristly, hairy on the back. Stamens usually 50. Capsules 2-3 cm equal or slightly longer than the pedicel, compressed striate. Seeds reniform, yellowish brown, spiny tubercled.



Figs. 1-6. *Cleome felina* Linn. f. 1. A twig; 2. Sepal (ventral view); 3. Petal (ventral view); 4. Stamen; 5. Gynoecium; 6. Seed.

ACKNOWLEDGEMENT

We are thankful to the Director, Botanical Survey of India, Calcutta for providing the facilities.

BOTANICAL SURVEY OF INDIA,
PUNE 411 001,
September 29, 1979.

S. K. MALHOTRA
SIRASALA MOORTHY

32. *ARTHRAXON MEEBOLDII* STAPF—A GRASS NEW TO KASHMIR

(*With a text-figure*)

Arthraxon Beauv. (Poaceae) is a genus of 20 species (Airy Shaw 1966) native to old world tropics. Some species are introduced or adventive in the temperate regions of the world. From the Kashmir Himalayas several species of *Arthraxon* Beauv. have been reported (Bor 1960, Stewart 1972). During studies on the alpine fodder grasses of Kashmir we collected several specimens of *Arthraxon* Beauv. which on critical scrutiny turned out to be *Arthraxon meeboldii* Stapf. The literature revealed that this taxon has not been reported so far from this area.

The present paper records for the first time the occurrence of this grass from the Kashmir valley. The note is supplemented by short description and illustration. The voucher specimens have been deposited in the Herbarium, Kashmir University.

Arthraxon meeboldii Stapf in Kew Bull. 449 (1908)

Annual. Culms ascending to prostrate; leaf margins ciliated with penicillate bulbous base hairs; Racemes 2-3 paniculate, densely pubescent with silky silvery hairs; spikelets binate; lower glume of sessile spikelet with a double row of muricate teeth; upper glume setosely acuminate, keeled upwards, complicate; lemma with a dorsal basal awn; palea small; anthers 3; styles 2, free; Lower glume of pedicelled spikelet rigidly keeled.

Flowering and Fruiting: August to November.

Specimens collected: Dachigam; in the shade of forest trees, HT: 902: Phalgam; moist places; HT: 746: Harwan; on the bund of water reservoir; HT: 840; Telbal; on the bank of Telbal nallah; HT: 650.

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KASHMIR (INDIA),
November 22, 1979.

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G. N. JAVEID

REFERENCES

BOR, N .L. (1960): The Grasses of Burma, Ceylon, India and Pakistan. Pergamon Press, Oxford.

AIRY SHAW, H. K. (1966): A Dictionary of the Flowering Plants and Ferns. Cambridge.

STEWART, R .R. (1972): Cat. Vas. Pl. of West Pakistan and Kashmir. Karachi.

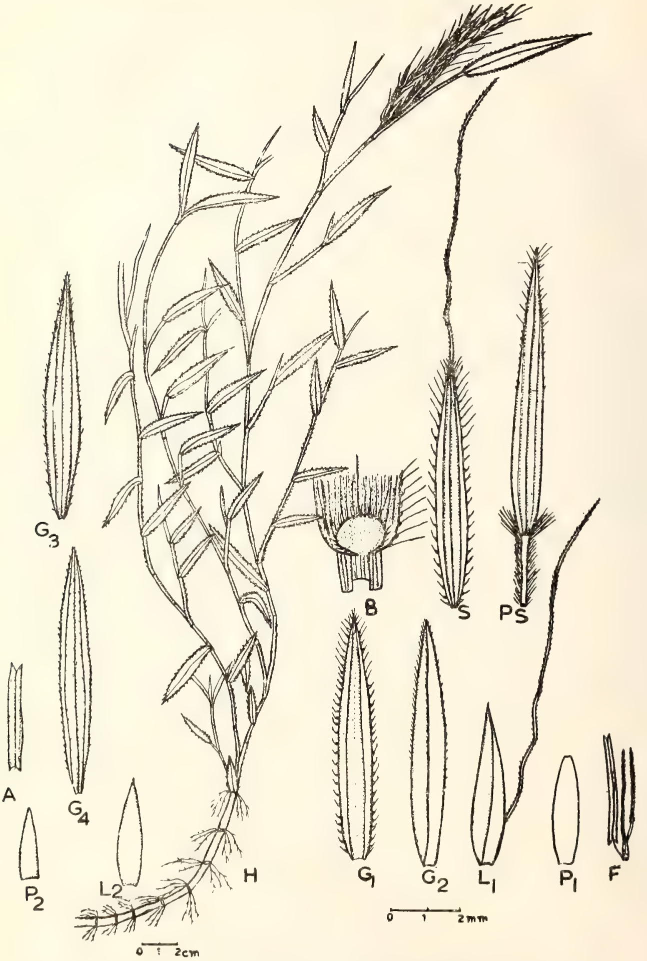

Fig. 1. *Arthraxon meeboldii* Stapf

H. Habit of plant; S. Sessile spikelet; PS. Pedicelled spikelet; B. Ligule; G_1. Lower glume of sessile spikelet; G_2. Upper glume of sessile spikelet; L_1. Lemma of sessile spikelet; P_1. Palea of sessile spikelet; F. Flower of sessile spikelet; G_3. Lower glume of pedicelled spikelet; G_4. Upper glume of pedicelled spikelet; L_2. Lemma of pedicelled spikelet; P_2. Palea of pedicelled spikelet; A. Anther of pedicelled spikelet.

33. NOTES ON *VACCINIUM LESCHENAULTII*—COMPLEX (VACCINIACEAE) IN SOUTH INDIA

(*With two text-figures*)

Wight (1848) described *Vaccinium leschenaultii* based on his collections from the Nilgiris. He remarked, "...leaves shortly petioled, ovate-elliptic, serrated, acute..." Further, Wight (1850) described another species *viz. V. rotundifolium* from (Kelso cottage) Ceylon, mainly based on the shape of the leaf, "... leaves orbicular, coriaceous, entire or slightly crenulato-serrate...." Later C. B. Clarke (1882) treated this taxon as a variety of *V. leschenaultii.* Subsequently, Gamble (1921) reported this variety from the Nilgiris in his Fl. Pres. Madras. The figure given by Wight (Ill. t. 139. 1850) shows only orbicular leaves all over the branch. While undertaking critical studies on the specimens of *Vaccinium leschenaultii* Wight represented at Madras Herbarium, we came across some interesting specimens [*M. A. Lawson s.n.* (Acc. No. 29181); *Vajravelu* 34923, 43511; *Subbarao* 40440, 41527] bearing both orbicular and ovate-elliptic leaves on the same branch. Hence we doubt whether this variety *rotundifolia* can be kept as a distinct taxon.

It is also observed that some of the specimens (*Collector?* 13450) collected from Neterikal, Tirunelveli Dt. show persistent, leafy bracts as compared to other specimens of *V. leschenaultii* Wight. C. B. Clarke (1882) described var. *zeylanica* based on the presence of persistent, leafy bracts and he recorded this variety only from Ceylon. Hence the present report of its occurrence in Tirunelveli Dt. is of phytogeographical interest and forms a new distributional record for India. We keep this variety as distinct at present, as such a type of persistent, leafy bracts are not at all seen in any of the specimens of *V. leschenaultii* Wight collected from all other areas in South India. However, more field studies coupled with suitable evidences from experimental taxono-

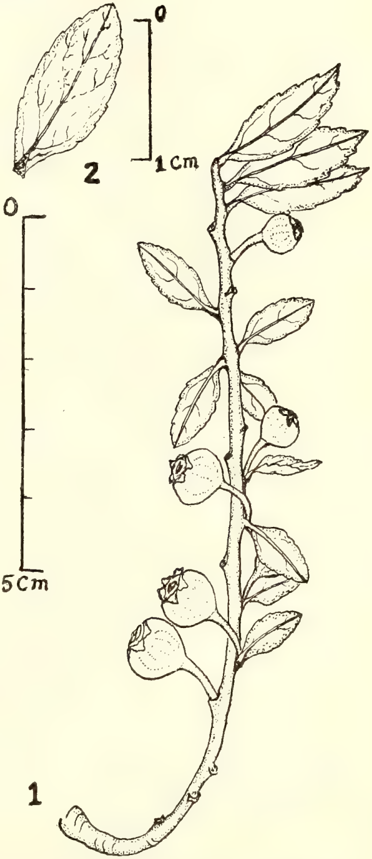

Fig. 1-2. *Vaccinium leschenaultii* Wight var. *zeylanica* C. B. Clarke: 1. Infructescence showing persistent bracts; 2. Bract.

my can only fix the exact status of this taxon.

KEY TO THE VARIETIES OF *Vaccinium leschenaultii* WIGHT OCCURRING IN SOUTH INDIA

Bracts up to 1.5 mm broad, lanceolate, not leafy, deciduous .... var. *leschenaultii*

Bracts up to 8 mm broad, ovate-elliptic, leafy, persistent .... var. *zeylanica*

V. leschenaultii Wight var. **leschenaultii** Wight Ic. 4(1): 5, t. 1188, 1848; Bedd. Fl. Sylv. 3: t. 227. 1872; C. B. Clarke in Hook. f. Fl. Brit. India 3: 455. 1882; Gamble, Fl. Pres. Madras 742. 1921 & 2: 582. 1957 (rep. ed.). *V. leschenaultii* Wight var. *rotundifolia* sensu Gamble, Fl. Pres. Madras 742. 1921 & 2: 522. 1957 (rep. ed.).

Distribution: INDIA. TAMIL NADU: Anamallais, Palnis, Nilgiris, KERALA: Idukki Dt.

V. leschenaultii Wight var. **zeylanica** C. B. Clarke in Hook. f. Fl. Brit. India 3: 455. 1882; Trimen in Handb. Fl. Ceylon 3; 61. 1895.

Shrubs or small trees, glabrous excepting the tender branches. Leaves 1.5-5.0 × 0.7-2.4 cm, ovate-elliptic, acute or acuminate, serrate, coriaceous, glabrous, shortly petiolate. *Bracts* 0.7-2.2 × 0.3-0.8 cm, leafy, ovate-elliptic, acute, persistent. *Berries* ± 8 mm across, globose, glabrous. (Figs. 1 & 2).

Specimen examined: INDIA: TAMIL NADU: Tirunelveli Dt.: Neterikal, 22 September 1916, *Collector?* 13450.

ACKNOWLEDGEMENTS

We are grateful to Dr. N. C. Nair, Deputy Director, Southern Circle, Coimbatore for facilities and encouragement. Our thanks are due to Dr. A. N. Henry, Systematic Botanist and Sri M. Chandrabose, Botanist for helpful suggestions.

SOUTHERN CIRCLE,
BOTANICAL SURVEY OF INDIA,
COIMBATORE-641 002,
February 14, 1979.

V. CHITHRA
R. RAJAN

34. *CRYPTOLEPIS GRANDIFLORA* WIGHT—A NEW RECORD FOR ANDAMANS

Cryptolepis grandiflora Wight, a specimen collected from South Andaman by S. Kurz; was identified up to the genus. During reorganisation work we noticed the interesting specimen and after critical examination identified it as *Crytolepis grandiflora* Wight; A review of literature and herbarium specimens available shows that the species is reported from Tamilnadu, Kerala and Karnatak. It is now reported from Andamans.

A short descriptive note is given below:—

Cryptolepis grandiflora Wight; Wight Ic, t. 831; F.B.I. 4: 5, 1883.

Twining glabrous shrubs, flowers in very lax slender, few flower axillary or terminal peduncle, calyx with 5 scales within, corolla lobes overlapping, filaments free, anthers acuminate, leaves obovate oblong, obtuse or mucronate at apex, glaucous beneath, 6-8 pairs of nerves arched near the margin.

Specimen examined: Mornur, South India, 2100 ft, 29-10-1906; C.E.C. Fischer 517 (CAL); Papanasam to Mundandurai, Kerala, 18th Feb. 1913, D. Hooper and M. S. Ramaswami 39291 (CAL); Karnatak, G. Thomson *s.n.* (CAL); *South Andaman; S. Kurz s.n.* (*CAL.*).

ACKNOWLEDGEMENTS

We wish to thank the Deputy Director, Central National Herbarium for all facilities and Dr. K. Thothathri and Dr. N. C. Majumdar for valuable advice.

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HOWRAH, W. BENGAL,
September 21, 1978.

AMIT SINHA
GIRIJA SANKAR GIRI

35. OCCURRENCE OF *PITHOPHORA KEWENSIS* WITTROCK IN BANGLADESH

(*With a text-figure*)

The interesting genus *Pithophora* has so far not been recorded from any part of Bangladesh and is reported here for the first time with the specis *Pithophora kewensis* Wittrock. It is generally found to grow in freshwater habitat both in Tropical and Sub-tropical regions. Some authors namely Hoek (1959) consider *P. kewensis* Wittrock as a synonym of the American species *P. oedogonia* Wittrock.

The algae was was collected by us from the Karnafuli River, Chittagong (Bangladesh), on 12th September, 1975 attached to a log by means of its branched unicellular rhizoids. The plants are about 4 cm tall and the filaments are freely branched. The branches may be solitary, alternate or on one side and sometimes opposite in the case of lowest branches. Branches originate from a short distance below the top of the cells. These morphological characters agree well with that of the descriptions given by Patel (1971). The diameter of the main filaments varies from 55-75μ which agrees with the measurements given by Wittrock (1877). The length of the vegetative cells are much variable and in general, they are 8-15 times the diameter. The branches of the first degree are of approximately the same diameter as the main filament.

Thick walled, terminal and intercalary akinetes are found in the materials. They are fewer in number. Intercalary akinetes are 70-80 μ in diameter and 110-224 μ in length which agrees well with the dimensions given by earlier

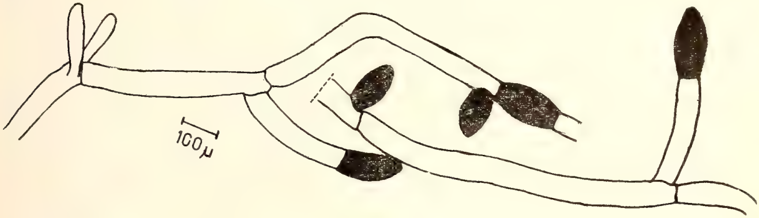

Fig. 1. *Pithophora kewensis* Wittrock, portions of the filament with terminal and intercalary akinetes.

workers (Wittrock 1877, Heering 1921, Patel 1971). Terminal akinetes vary from 55-84 μ in diameter and 140-259 μ in length and agree with Patel (1971) but differ from Wittrock (1877) where they were rather greater.

Thanks are due to Prof. Dr. A. K. M. Nurul Islam for his valuable comments on the identification of the species.

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April 4, 1979.

REFERENCES

*HEERING, W. (1921): Die Susswasser Flora, 7, Chlorophyceae. *4*: 3-61.

HOEK, C. V. (1959): Caribbean Fresh and Brackish water Chlorophyta. *Blumea.* *9*(2): 590-625.

PATEL, R. J. (1971): Cytotaxonomical studies on *Pithophora kewensis* Wittrock. *Phykos.* *10*(1 & 2): 18-23.

WITTROCK, B. (1877): On the development and systematic arrangement of the *Pithophoraceae. Nova Acta Regiae Soc. Sci., Upsal.* 3, series I, Volumen extra: 1-80.

* Not seen in original.

36. DISTRIBUTIONAL NOTES ON CERTAIN RECENTLY DESCRIBED TAXA

Borreria eradii Ravi, *Heliotropium keralense* Sivarajan & Manilal, and *Phyllanthus kozhikodianus* Sivarajan & Manilal, are but a few of the taxa discovered and described recently from S. India. A perusal of the material of the concerned genera at the Central National Herbarium, Howrah, and those at the herbarium of Botanical Survey of India, Shillong, revealed interesting information regarding their extended distribution in India and the data are presented here.

Borreria eradii Ravi (J. Bombay nat. Hist. Soc. 66: 539-541. 1970) has been invariably (except in the case of a single sheet, Vivekanandan 46570, in CAL) identified as *Borreria articularis* (*Spermacoce hispida*). Though closely resembling, these two species can well be distinguished by the prominently winged stems, conspicuously veined leaves, short campanulate flowers and the glandular papillae on the calyx in the former.

This particular species is a common weed in the sandy loam or laterite soils, mostly on the hill slopes in Kerala, and can at once be recognised by its yellowish green colour. Interestingly enough, this species is represented in these herbaria from various eastern States, like Assam, Meghalaya, Mizoram and W. Bengal and even from the neighbouring countries like Bhutan and Nepal. On Gauhati-Shillong roadside, it is a quite common weed.

Specimens examined:

Assam: Panigrahi 1878, 18722 & 9246. Sivarajan 28637.

Meghalaya: Patnaik 10963 (Khasi & Jaintia Hills).

Mizoram: Dutta 34103. *W. Bengal*: Thothathri 9436 (Kalimpong), Mukherjee 6211 'Sukna'). *Sikkim*: Majumdar 169 (Gangtok) Sengupta 296 (Rungpo). *Kerala*: Vivekanandan 46570, Sivarajan 464. *Bhutan*: Thothathri 10323, Subba Rao 136, Coll: 353, Sengupta

863, Mukherjee 6181. *Nepal*: Hara *et al.* 1298.

Heliotropium keralense Sivarajan & Manilal *Heliotropium indicum* as recognised in the past, has been a complex with at least two different taxa, more or less similar in vegetative condition. The one having pink flowers with the corolla tube much longer than the calyx and covered with short pubescent hairs on the outside is *H. indicum*. Sivarajan and Manilal (Jour. Indian Bot. Soc. 51: 348-350. 1972) separated the white flowered taxon with corolla tube almost as long as the calyx and covered with long villous hairs into a new species namely *H. keralense*. However, there seems to be no good character to distinguish these species in their vegetative phase.

This species is originally described from Kerala, where it is a very common weed in the wet lowlands, often growing in association with *H. indicum* Linn. But it is now found to have a much wider distribution.

Specimens examined:
Assam: A. S. Rao 39038 (Kamrup), Verma 46257 (Lakhimpur), Nath 13433 (Tangla), R. S. Rao 9827 (Kaziranga), Panigrahi 9336 (Gauhati).
Andamans: Thothathri 9189. *Karnataka*: Barber 6807.
Kerala: Calder 1573, Sivarajan 191 (type), 997.
Tamil Nadu: Wight 2065, Subramaniam 8139, 3459 (Madurai), Sebastine 801 (Coimbatore).
Orissa: G. V. Subba Rao 30198.

Phyllanthus kozhikodianus Sivarajan & Manilal, (J. Indian bot. Soc. 56: 165-168. 1977), is however, the most confused of these. This species, originally reported from Kerala, is closely related to *P. rheedii* Wt., from which it can be distinguished by its rather unbranched habit, different disc glands and sepals; and to *P. rotundifolius* Klein., from which it could be made out by its leaves, pedicelled male flowers, staminal filaments which are free above, and larger capsules. The identity of the specimens of this species at 'CAL' is confused with other species and kept accordingly. Puri 4306, from Maharashtra, is labelled as *P. niruri* Linn., but can be distinguished by its equilateral leafbases and the presence of six sepals which are 1-veined, in both male and female flowers. Wadhwa 5462, identified to be *P. fraternus* Webster, has two different taxa mixed up, of which one is definitely *P. kozhikodianus,* since this possesses spreading, deeply bifid styles unlike *P. fraternus*. Interestingly enough, one of us (V.V.S.) could collect it from the grassy slopes alongside Gauhati-Shillong Road.

Specimens examined:
Andhra Pradesh: Subramanian 6950 (Chittoor), Balakrishan 10804 (Visakhapatanam),
Assam: Sivarajan 28701 (Gauhati). *Kerala*: Sivarajan 1762 (type).
Maharashtra: Puri 4306 (Khandesh), Pataskar 101445.
Rajasthan: Wadhwa 5469 (Jhalawar), Wadhwa 5462, in part.
Tamil Nadu: Sebastin 12616 (Madurai).

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Thanks are due to the authorities of Botanical Survey of India, Howrah, for the facilities.

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CALICUT, KERALA.
V. V. SIVARAJAN

BOTANICAL SURVEY OF INDIA,
SHILLONG,
J. JOSEPH
February 14, 1979.

37. POWDERY MILDEW OF WALKING FERN (*CAMPTOSORUS RHIZOPHYLLUS*)—A NEW RECORD

Walking ferns are very common in waterfall areas and moist shady areas of Seethammadhara area of Visakhapatnam, Andhra Pradesh. Powdery mildew fungal occurrence on *Filicineae* is very rare. During our periodic surveys of powdery mildews on flora of Visakhapatnam, we encountered in December 1973 some walking fern plants infected by a powdery mildew. A brief description of the pathogen and the symptoms it causes on the susceptible host fern are described below.

In the early stages of infection, small circular white powdery spots of the fungus appeared on the upper surface of the leaves. With advancement of age, the mildew turned dusty grey. New plants bred from the leaf-tips of walking fern were also infected. The infected leaves turned yellow due to the fungal infection.

Morphology of the fungus: Mycelium superficial, hyaline, septate, 3.0-4.5 μm wide, attached to the leaves by means of appressoria. Sometimes bulbous haustoria were produced into the host's epidermal cells. Conidiophores were erect, simple, septate, measuring 58-102 × 10-18 μm and arising vertically and bears chains of conidia. Conidia mature epigenously and are elliptical to cylindrical, 25-36 × 10-15 μm in size. No cleistothecial formation was observed.

According to Yarwood's key (1973) based on conidial characters, the powdery mildew was identified as *Erysiphe cichoracearum* DC. There was no previous record of powdery mildew infection on walking ferns and this is a new record for India. and *Camptosorus rhizophyllus* is an addition to the host range of *E. cichoracearum* DC.

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April 11, 1979.

REFERENCE

Yarwood, C. E. (1973): Pyrenomycetes: Erysiphales in *The Fungi-An Advanced Treatise* vol. *IV A* (Edited by Ainsworth, G. C., Sparrow, F. K. and Sussman, A. S.). Academic press; New York. pp. 71-86.

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THE SPARROW-HAWKS (*ACCIPITER*) OF THE ANDAMAN ISLANDS[1]

G. F. Mees[2]

(*With a plate & three text-figures*)

The identification of sparrow-hawks (*Accipiter*) collected in the Andaman Islands has caused problems. A study of all the specimens known from these islands revealed that they belong to three species: resident *A. virgatus*, represented by an endemic subspecies here described, and the winter visitors *A. nisus* and *A. gularis*. A fourth species, *A. soloensis*, has erroneously been recorded but actually is likely to occur as a winter visitor, being already known from the Nicobars. These species and *A. badius* (not known from the Andamans but widely distributed in south-east Asia) have often been confused. In this paper the characters by which they may be distinguished, their distribution, geographical variation and migrations are discussed.

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[2] Rijksmuseum van Natuurlijke Historie, Leiden.

INTRODUCTION

The occurrence of sparrow-hawks in the Andaman Islands has been known for over a century or, to be exact, since 24 April 1873, when W. R. Davison obtained an adult female (Hume 1874: 141). Two years later Hume (1876: 280) recorded three more specimens: a juvenile male and two juvenile females, which had been forwarded to him by Captain Wimberley. Breeding was established early in the present century by Osmaston (1906) and Wickham (1910).

These older authors, using binary nomenclature, identified their birds as *Accipiter virgatus*, although Hume, observing some differences between mainland specimens of *A. virgatus* and Andaman birds, wondered whether the name *A. gularis* might be applicable to the latter. With the introduction of ternary nomenclature, the names *A. gularis nisoides* (cf. Baker 1928: 164), *A. virgatus nisoides* (cf. Peters 1931: 223), *A. virgatus gularis* (cf. Ali & Ripley 1968: 250) and *A. virgatus besra* (cf. Brown & Amadon 1968: 469) came into use for the Andaman resident birds.

As far as I know, the four specimens recorded by Hume and a single specimen of a different species, the winter visitor *A. nisus nisosimilis* (cf. Hume 1876: 280), remained the only sparrow-hawks ever obtained in the Andamans until Abdulali (1965: 507) recorded three more, collected by him personally in 1964, under the name *A. virgatus gularis*.

Incidental to a study of resident *A. virgatus* from Formosa (Taiwan), I examined the adult Andaman female previously recorded by Hume (BM no. 85.8.19.690) which I found to be close to *A. v. affinis* from continental Asia, but smaller. This led me to observe: "This bird probably represents an undescribed subspecies, characterized by small size. The breeding records quoted by Abdulali (1965: 507) would refer to this form and certainly not to *A. v. gularis*, under which name he lists them" (Mees 1970: 291).

From the preceding notes it will be clear that the identity of the sparrow-hawks inhabiting the Andaman Islands was not yet definitely settled. Therefore I gladly accepted an offer by Mr Abdulali to forward for my examination the sparrow-hawks collected by him in the Andamans, together with some specimens from peninsular India and one from Camorta Island, Nicobars, for comparative purposes. In addition to the specimens collected in 1964, this material included a bird obtained during a more recent visit to the Andamans, making four altogether from that locality.

The results of this study can be summarized as follows: three species of *Accipiter* are known from the Andamans, of which one (*A. virgatus*) is a resident belonging to an endemic subspecies here described, and two (*A. nisus* and *A. gularis*) are winter visitors. In literature one finds a fourth species listed from the Andamans: according to a number of recent authors, *A. soloensis* would occur as a winter visitor. As will be explained in the discussion of *A. soloensis*, the record is erroneous although actually the species may be expected for it is an apparently regular visitor to the Nicobars.

An unexpected additional result is the identification of two specimens of *A. gularis* from Point Calimere, southern India. These are apparently the first records from continental India and their location makes it likely that in fact this migrant is more widely distributed but has not been recognized. Confirmation of this has already been obtained to a certain extent.

It proved impossible to discuss the Andaman sparrow-hawks properly without paying attention to related species and subspecies from the mainland of south-east Asia and for that reason this paper has expanded beyond the limits, if not the scope, originally envisaged. The need for this came as a surprise, for the recent works of Brown & Amadon (1968) and Wattel (1973) had given me the impression that little museum work remained to be done on the genus *Accipiter*. Actually, and in spite of the fine work done by the authors just mentioned, a lot of traditional misconception remains to be cleared up. In this paper a modest beginning will be made.

Apart from the specimens individually recorded, I have measured as a basis for comparison ten adult males and ten adult females each of *A. v. virgatus, A. g. gularis* and *A. soloensis* from Java, all from the collection of the Rijksmuseum van Natuurlijke Historie (RMNH). Additional material recorded in the text and in the tables is from the American Museum of Natural History (AMNH), Bombay Natural History Society (BNHS), British Museum (Natural History) (BM), Merseyside County Museum (MCM), Naturhistorisches Museum Wien (MV), and United States National Museum (USNM).

IDENTIFICATION

Several species of sparrow-hawks resemble each other closely, especially in the immature plumages, and this has led to frequent misidentifications. It is therefore necessary to discuss the characters by which the following species can be differentiated: *A. soloensis, A. badius, A. virgatus* and *A. gularis. A. trivirgatus* must also be mentioned in this connexion as in plumage it shows some resemblance to *A. virgatus*, but skins can always be distinguished by their heavy feet; for additional characters, see Mayr (1949).

In this section I shall discuss the various characters that in literature have been used for identification, and have this followed by a key. Many of the descriptions found in literature are quite satisfactory for the identification of adult birds, but break down when birds in immature plumage are studied. Indeed, it is my opinion that plumage characters are of little use in the identification of immature birds, an opinion supported by the many misidentified specimens one finds in collections. Therefore I have in the key almost ignored plumage characters, but have worked with measurements and proportions. My ambition has been to enable anybody to identify specimens by taking a few simple measurements, and without any comparative material. Therefore characters that can only be evaluated by comparison have also been avoided. I believe that correctly sexed material can always be identified with the key. As regards wrongly sexed specimens (of which unfortunately large numbers clutter collections) I am not so sure.

Median stripe down the throat. This character has been used extensively to distinguish between *A. virgatus* (stripe broad) and *A. gularis* (stripe narrow). Whereas in *A. virgatus* this is indeed a reliable character inasmuch as this species shows in all plumages a comparatively broad stripe, it is not so satisfactory in *A. gularis*, being variable to the extent that in some specimens it is practically absent, in others so broad as to equal or almost to equal certain individuals of *A. virgatus*. Only when direct comparisons are made will it be seen that the former has the stripe darker and more sharply defined. If a bird has a broad and somewhat fluffy looking median stripe, it is definitely not *A. gularis*. Adult specimens of *A. soloensis* rarely show a median stripe and if it is present, it is grey rather than blackish, but birds in immature plumage have it invariably, blackish and fairly broad, usually supported by a few smaller and narrower lateral stripes. In both adults and immatures of *A. badius* the median stripe is frequently present, moderately developed, but other individuals only show a few inconspicuous non-median longitudinal striae on the throat.

Bands on the tail. In two species, *A. badius* and *A. soloensis*, the adult birds have or may have the middle pair of rectrices, which in the closed tail covers the others, without distinct cross-bars. In *A. soloensis* these feathers are dark grey, gradually changing to blackish towards the tips. In *A. badius*, which is lighter grey above, there is a distinctive subterminal black band followed by a narrow white margin; sometimes there is also a suggestion of one or two dark cross-bars, but these are never fully developed. When studying material of these two species, one should be aware of the possibility that the central rectrices are missing: the other rectrices have cross-bars, not very pronounced in *A. soloensis*, very distinct in *A. badius*.

I do not understand the remark made by Brown & Amadon (1968: 514) under the heading Field Characters of *A. soloensis*: "Could be confused with the Shikra (*A. badius poliopsis*), which occurs in part of the range, but should be distinguishable by (1) upper side much clearer blue grey than the Shikra...". In my material the difference is just the other way round: the upper parts of adult *A. badius poliopsis* are light blue-grey, whereas *A. soloensis* is dark grey above.

In general terms the bands can be described as follows:

A. virgatus: 4 broad dark bands, about as wide as the pale bands separating them; in some individuals all four bands are visible, in others the proximal one is concealed under the upper tail coverts.

A. gularis: 4, sometimes 5 bands, usually narrower than the pale bands separating them; usually four bands are exposed.

A. badius: central feathers in adults with only the terminal band well-developed, the others weakly indicated or entirely absent; lateral rectrices of adults and juvenile tails with 4-6 bands.

A. soloensis: central rectrices of adult males usually without bands, of adult females sometimes without bands; lateral rectrices of adults and juvenile tails with 4-6 bands.

One of the problems is to decide exactly how many bands there are. Whereas in the distal part of the tail this is no problem, in the proximal part there is often some darkening near the base of the feathers which could or could not be counted as a band. One might try to escape from this problem by counting only the exposed bands, visible without looking below the upper tail-coverts, but that does not help much as usually one band is about half covered by the coverts, and moreover especially the larger of these coverts are frequently missing in skins, so that whether or not one counts a band comes to depend on how many coverts the specimen has lost in the process of preparation. In addition there is a relatively large variation in the number of bands, even within one species (as listed above). Evidently the bands of the tail are of very limited use in identification; all I would dare to say is that *A. virgatus* can usually be recognized by having the bands broad and well-defined.

Under wing pattern. Adult individuals of *A. soloensis* differ from all other species in having the underwing not barred; the outer primaries are blackish below, the remainder of the underwing is white or pale buffish. Unfortunately, in immature birds the outer primaries are more or less barred underneath and such birds also have the underwing coverts with some dark spotting. Previous authors (e.g. Brown & Amadon 1968: 515) have used this character but without mentioning its restriction where immature birds are concerned. *A. virgatus* and *A. gularis* always have a strongly barred underwing pattern, but *A. badius* is variable: some specimens are as lightly barred as immature *A. soloensis*, others are almost as heavily barred as *A. virgatus* and *A. soloensis*. In other words, only adult *A. soloensis* can be readily distinguished by this character. The illustrations in King & Dickinson (1975: pl. 6) show the differences between adult birds of *A. badius*, *A. virgatus* and *A. soloensis* very well as far as colour pattern is concerned, but the artist has completely missed the structural differences in wing shape; surely *A. soloensis* has pointed wings and not the extremely blunt ones indicated, and the same can be said in a lesser degree of *A. badius*. The figures given by Grossman & Hamlet (1965: 247) are much better.

Colours of unfeathered parts. As is usual in collections, only a minority of specimens has the colours of the unfeathered parts indicated on the labels.

A. soloensis: iris of ♂ ad. dark brown or dark red, of ♀ ad. and immature birds of both sexes yellow or orange-yellow, bill slate to black, cere orange-yellow to orange, feet orange-yellow to orange. The sexual difference in iris colour must have been noted by many collectors, and was recorded by La Touche (1932: 188-190), Kolthoff (1932: 138-139), Stresemann (1941: 85), etc. It is confirmed by material examined by me, collected by Bartels, Coomans de Ruiter, Jacobson & van Heurn, and Kooiman.

A. g. gularis: iris of ♂ ad. red-brown, of ♀ ad. and immature birds of both sexes yellow, bright yellow or dark yellow, bill dark grey with a black tip, cere greenish, feet light greenish to bright yellow, nails black. Sexual dimorphism in colour of the iris was already recorded by Swinhoe in Gurney (1863), followed by La Touche (1932: 193-194) and Shaw (1938: 153) and is confirmed by such specimens in our collection as have the colours of the unfeathered parts recorded on their labels.

A. g. iwasakii: iris in adults of both sexes yellow (based on only one specimen of each sex).

A. v. virgatus: iris ♂ ad. dark cadmium yellow, ♀ ad. yellow, in immature birds greyish yellow or greenish yellow, in a nestling (♀) greenish grey, bill dark grey to blackish, cere greenish, feet light greenish to bright yellow, nails black. As far as can be ascertained from the material at hand, there is little sexual dimorphism in iris colour, but from this species the data sheets of the Bartels collection are missing, and the assumption that the adult male has a yellow iris is based on two specimens only.

A. v. affinis: iris ♂ ad. orange (BM no.

1937.1.17.85), ♀ ad. bright yellow (BM no. 1949 Whl. 1-161). See also Deignan (1945: 67).

A. v. besra: iris ♂ ad. orange-yellow (BM no. 1959. 19.1), orange-red (BM no. 1956.44. 8) or bright orange-red (BM no. 1956.44.7).

A. badius: iris ♂ ad. light orange, ♀ ad. yellow, ♂ im. greenish yellow, bill black, near gape greyish or bluish, cere green to greenish yellow, feet yellow, nails black.

Note that the adults of *A. soloensis* and *A. g. gularis* have a pronounced sexual dimorphism in iris colour, that is absent in *A. virgatus* and *A. badius*, where adult males have the iris merely deeper in colour, orange rather than yellow.

It is not surprising that the sexual dimorphism in iris colour, combined with the generally poor labelling of specimens, has been too much for ornithological illustrators. Thus, Brown & Amadon (1968) show the adult male of *A. gularis* with a yellow iris (pl. 62 fig. 1), the adult female of *A. soloensis* with a dark brown iris (pl. 77 fig. 2). The adult male *A. gularis* figured in Etchécopar & Hüe (1978: pl. 4 fig. 3) also shows a yellow iris. The bird so beautifully illustrated in Kuroda (1936: pl. XXIV fig. 2) under the name *A. v. virgatus* ♂ ad. shows hardly a trace of a median stripe down the throat, neither has it the dark streaks on the upper breast which are characteristic of that species. The measurements of this specimen, provided by Kuroda (l. c.: 513): wing 166, tail 118.5 mm, prove its identity as *A. gularis*. Therefore the yellow iris pictured is definitely wrong.

A. soloensis differs from all others by the brighter more orange colours of cere and feet and the difference remains visible in skins, inasmuch as all specimens of *A. soloensis* examined by me, be they adults or immatures, can be recognized by the pale yellowish cere, which contrasts conspicuously with the dark bill and the dark feathers of the forehead. For identification this is, however, of limited value: birds with a dark or blackish cere (in skins) are not *A. soloensis*, but it does not always work the other way round as in all three other species occasional skins are found in which the cere (sometimes also the bill) is pale.

Wing shape. A difference in shape of the wing tip between *A. virgatus* and *A. gularis* was noted as long ago as 1862 by Schlegel (1862: 32-33), the former having the: "Quatrième rémige dépassant à peine la cinquième", the latter having: "la quatrième rémige dépassant notablement la cinquième". This character was accepted as an excellent and highly reliable one by Ogilvie-Grant (1896: 105), but rejected by Hartert (1910: 211): "I find, however, that this character varies considerably and is therefore not reliable". Subsequent authors have again paid attention to the wing-formula, the proportional lengths of the primaries. Apart from the existence of variation as already noted by Hartert, characters that have to be described in terms of "a little larger" against "notably larger" have an element of inexactness and subjectivity that makes them difficult to use. A far more useful character was introduced by Voous (1950), probably inspired by Mayr (1949). Voous measured the wing tip, being the difference in length between the longest (be it the third, fourth of fifth) primary and the tenth (innermost) primary; this measure he also expressed as a percentage of the whole length of the folded wing. Wattel (1973) followed suit and provided a whole series of very useful measurements. I find the length of the wing tip the easiest and most reliable character

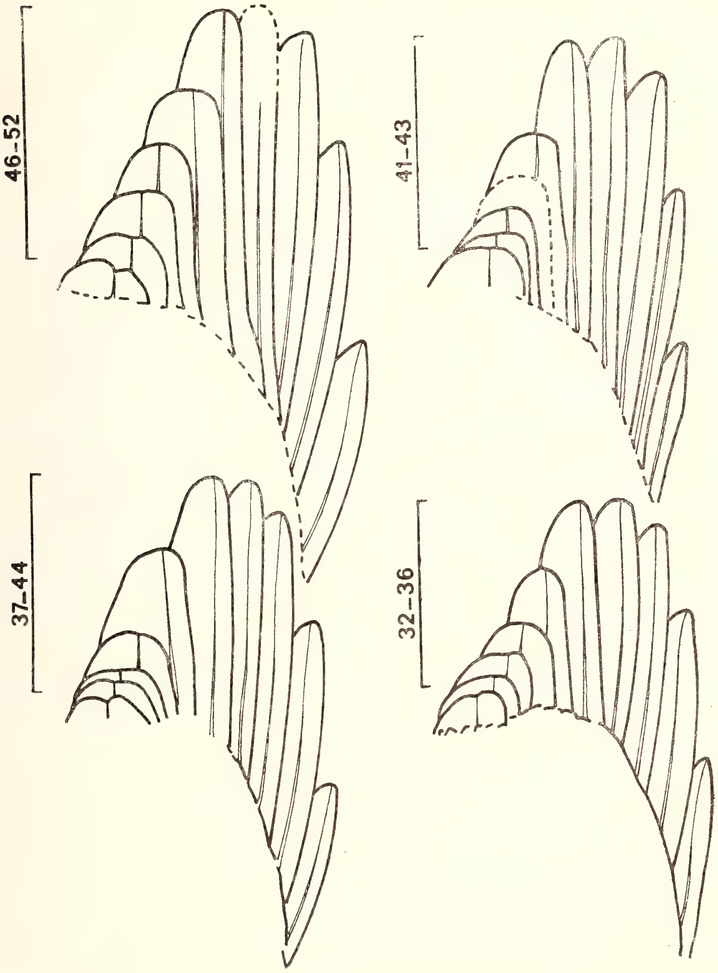

46–52
37–44
41–43
32–36

Fig. 1. Wing tips. Top: *A. v. affinis*, left ♀, right ♂. Botton: *A. v. virgatus*, left ♀, right ♂.

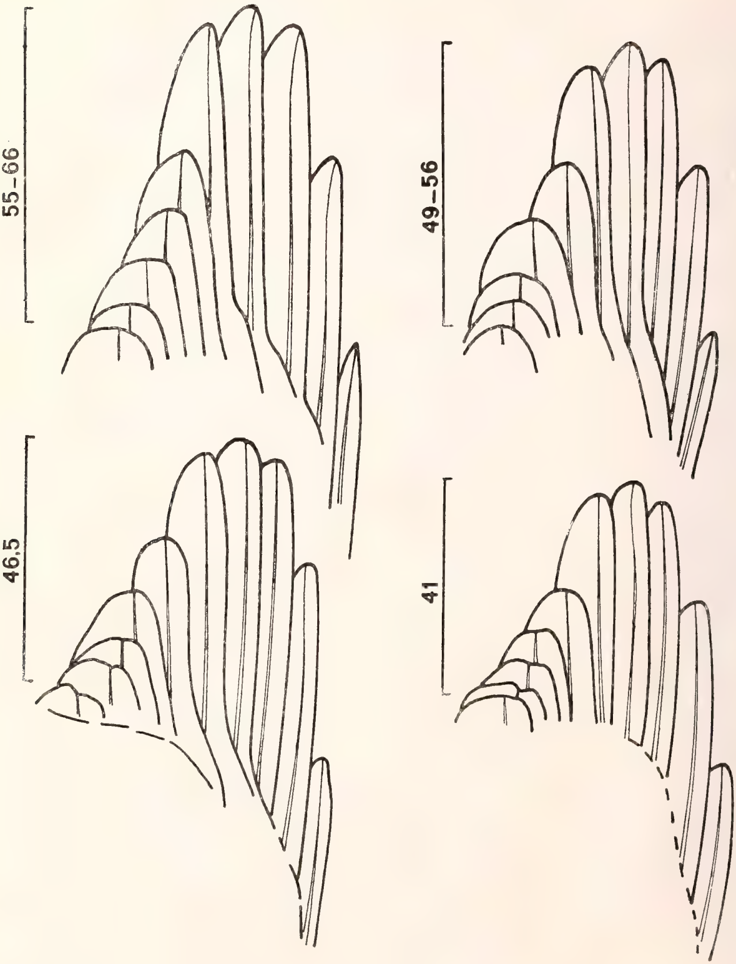

55–66
46,5
49–56
41

Fig. 2. Wing tips. Top: *A. g. gularis*, left ♀, right ♂. Bottom: *A. g. iwasakii*, left ♀, right ♂.

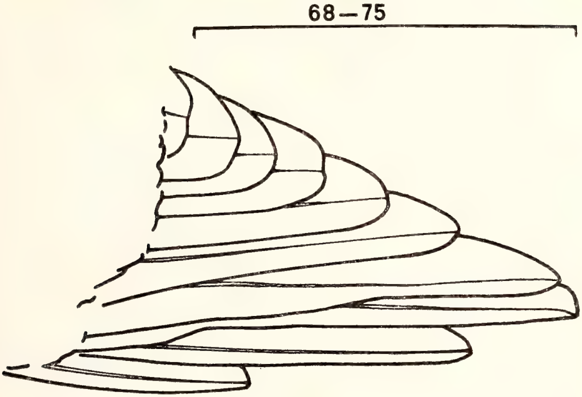


Fig. 3. Wing tip of *A. soloensis* ♀

there is. By simply measuring the length of the wing tip, a complete separation between *A. virgatus* and the other three species can be made. In the available material a complete separation between *A. soloensis* on the one hand against *A. g. gularis* and *A. badius* on the other hand is also possible, but the extreme measurements are so close that in very large series the possibility of some overlapping must be envisaged. Finally, *A. badius* and *A. g. gularis* cannot be separated by wing tip length and wing tip index, these being very similar in both. In their case, wing length and tail length have to be used.

It is necessary to mention that, within the confines of India, there is one other small sparrow-hawk with a very blunt wing: *A. butleri,* in which according to Wattel (1973: 33) the wing tip index is 22.3%. This species, being endemic to the Nicobars where *A. virgatus* does not occur, cannot be confused with it. The blunt wing will, however, serve to distinguish *A. butleri* from the migrant species *A. gularis* and *A. soloensis* which visit the Nicobars in the northern winter.

Foot-structure. Traditionally much attention has been paid to the structure of the foot in the classification of *Accipiter*-species; formerly the distinction between the genera *Astur* and *Accipiter* was largely based on it, species ascribed to the first genus having generally heavier feet with shorter toes. Of the species here discussed, *A. soloensis* and *A. badius* used to be placed in *Astur,* whereas *A. virgatus* and *A. gularis* (as well as *A. nisus*) were regarded as "typical" of *Accipiter,* having long and slender toes. Ali & Ripley (1968: 232-233) still use this old distinction in their key, where they separate *A. virgatus* (including *A. gularis,* regarded as a subspecies by these authors) from *A. badius* by the former having: "Middle toe without claw considerably longer than outer toe with claw", and the later: "Middle toe without claw about as long as outer toe with claw". Actually, the difference is slight and in both species as well as in *A. gularis* the outer toe with claw is about equal in length to the middle toe without claw. It is true that *A. badius* has generally somewhat shorter toes than *A. virgatus*, but the relative proportions of the toes do not differ and therefore cannot be used for their separation. Whereas *A. soloensis* has, compared with *A. virgatus*, conspicuously short toes (see table), the same cannot be said of *A. badius*, which has the toes only a little shorter and less slender than *A. virgatus*.

Sexual difference in size. In the absence of weights, which would give a much better picture of the acutal differences between the sexes, I have been forced to use wing length as a measure of size differences between the sexes. It will be clear that, being one-dimensional, these do not do justice to the great differences in bulk they express so inadequately.

It is a pity that of several forms the numbers of specimens are insufficient to work out satisfactory averages, but even so it is evident that the sexual difference in size is a reliable specific character: within each species, even when that is divided into several well-differentiated subspecies, it is almost constant, but there are significant differences between the species. Summarizing from the table, it will be seen that the greatest sexual difference is found in *A. virgatus* (wing length of males 80-84% of that of the females), less so but still considerable in *A. gularis* (87-88%), and in *A. badius* (88.7-92.6%), and very little in *A. soloensis* (97.3%). It is tempting to speculate about possible explanations for these interspecific differences, but that is outside the scope of this purely descriptive contribution. Therefore I refer to the interesting discussions given by Brown & Amadon (1968: 26-28), and Amaden (1975), and only note that the two species with the greatest sexual dimorphism in size are bird-hunters, whereas the intermediate *A. badius* has a mixed diet and the species with the least dimorphism, *A. soloensis*, appears to feed mainly on insects, amphibians and reptiles (cf. Wattel 1973: 32).

IDENTIFICATION KEY

1a. In adult plumage, under surface of folded wings not barred; outer primaries black or blackish, remainder white or pale buffish; in the immature plumage, the outer primaries can be barred below; third primary usually longer than fourth, sometimes equal; wing tip 68-75 mm or *c.* 37% of wing length.....*A. soloensis*

b. In all plumages under surface of folded wings at least on the outer primaries distinctly barred dark brown-grey and white; third primary usually shorter than fourth, sometimes equal; wing tip 35-66 mm or 23-34% of wing length. 2

2a. Wing tip in males 35-43 mm, in females 41-52 mm, or 22.8-28.5% of wing length; under surface of folded wings entirely barred.......... .... *A. virgatus*

b. Wing tip in males 49-63 mm, in females 55-66 mm, or 27.6-34.2% of wing length; under surface of folded wing either entirely barred, or barring more or less restricted to the primaries. 3

3a. Wing in males 160-170 mm, in females 183-197 mm, tail in males 111-118 mm, in females 120-134 mm, or 64.7-71.3% of wing length; under surface of folded wing entirely barred. .... *A. gularis*

b. Wing in males 172-200 mm, in females 194-214 mm, tail in males 125-150 mm, in females 143-168 mm, or 70.7-78.5% of wing length; barring on under surface of folded wings somewhat variable, usually weak or absent on the secondaries.................. *A. badius*

ACCIPITER NISUS NISOSIMILIS (TICKELL)

Falco Nisosimilis Tickell, 1833, J. Asiat. Soc. Bengal 2: 571—Marcha, in Borabhum.

Material from the Andamans. ♀, x.1875. South Andaman, leg. J. N. Wimberley (BM no. 85.8.19.594), an immature bird in its first autumn. Wing 248, tail 174, tarsus 63, culmen from cere 15 mm.

Discussion. This migrant from Central Asia is a winter visitor to India and Burma, but it has never been recorded from Sumatra and the Malay Peninsula. The Andamans must be near the south-eastern limit of its winter range and it is unlikely that *A. nisus* is more than an occasional visitor to the islands. Its large size will serve to distinguish this species from other members of the genus occurring in the Andamans.

ACCIPITER VIRGATUS (TEMMINCK)

Characters. *A. virgatus* shows in most of its subspecies no more than a moderate sexual difference in plumage, but a conspicuous one in size. As regards sexual differences in plumage, adult males and adult females of *A. v. affinis* and *A. v. besra* differ only in the former having the back blackish grey, the latter having the back with a brownish tinge. There is no sexual difference to speak of in colour and colour pattern of the under surface. In *A. v. abdulalii*, on the other hand, the females are in colour similar to females of the mainland subspecies, but the male is distingiushed by the very different underparts. A character by which *A. virgatus* can in all plumages be readily distinguished from *A. soloensis*, *A. badius* and *A. g. gularis*, is found in its rounded wings, the wing-tip of the subspecies occurring in India being 35-43 mm in males, 41-52 mm in females, or 23.0-24.4% of the wing length. Middle toe long. Underwing strongly barred. A broad longitudinal middle stripe on the throat is present in all plumages.

Distribution. This species has an extensive range in south-east Asia. On the mainland it occurs along the Himalayas to as far west as Kashmir, in Assam, Burma, Thailand, Indo-China, central, south and east China; also Hainan and Formosa, southern peninsular India and Ceylon, the Andamans the Philippines, Borneo, Sumatra, Java, Bali and Flores.

Habitat. *A. virgatus* is essentially a forest bird, this in contradistinction to *A. gularis* which (at least in its winter quarters) prefers the more open types of vegetation provided by village gardens and cultivated country. The vertical range is from the lowlands to 3000 m.

Wattel (1973: 40) stated that: "The species is found in moist-deciduous forests and plantations in the mountains of southern India and Ceylon...in the equatorial belt it ranges mostly between 1000 and 2200 m". However, in Ceylon, an island certainly within the equatorial belt, *A. v. besra* ranges over all zones, from sea-level to at least 6000 ft (Whistler 1944: 249). In southern India, Ali (1969: 56) knew it from levels of 600-1200 m, but the specimens from Point Calimere (♀ ad.) and Bhavnagar (♀ im.) prove that it does visit the lowlands. As lowland forest has become so scarce through the activity of *Homo sapiens*, it will be difficult to decide whether the apparent restriction to the higher levels is actually caused by a preference for these levels, or is due to a forced retreat from the lowland as a result of human activities.

Although both Voous (1950) and Wattel (1973: 40) reported *A. virgatus* in the Sunda Islands as a mountain bird, it is not exclusively so, for Coomans de Ruiter (1936) found a nest in Koeboe, West Borneo, a lowland region remote from any mountains. Both Voous (1950) and Wattel (1973: map 4) overlooked this record as well as a whole string of other records from Borneo (summarized by Smythies 1957: 578; see also Smythies 1960: 149 and 1968: 152), and concluded mistakenly that in Borneo this species is known from Mt Kinabalu only. On the distributional map given by Brown & Amadon (1968; map 37) the Bornean race *A. v. rufotibialis* is also shown as restricted to Mt Kinabalu, although in their text these authors record it also from Mt Dulit and the Kelabit Plateau, which is of course still giving it much too limited a distribution. The clutch from Koeboe, collected by Coomans de Ruiter personally, is now in our collection (RMNH no. 73548); the two eggs agree well with eggs of *A. v. virgatus* from Java and I see no reason to question their identification. As Coomans de Ruiter mentioned an additional clutch from Koeboe and also two nests from Pontianak, it is evident that reproduction in the lowlands of West Borneo is not exceptional but takes place regularly.

In Java also, the assumption that *A. v. virgatus* is confined to mountain forest requires revision. Its range as defined by Voous (1. c.) is: "Java and Bali, at 1200-2200 m altitude; occasionally in the lowlands (juvenile from Brebes...less than 100 m)". Although Voous did mention the juvenile bird from Brebes, he did not comment on the material from Buitenzorg (270 m) that he examined and he failed to indicate that locality on his map. Neither did he discuss Soekaboemi (600 m). On the other hand, he extended the normal vertical range up to 2200 m on the basis of a single specimen from that altitude. That is how mountain birds are created in literature. Our collection contains specimens from the following lowland localities: Meester Cornelis, Buitenzorg, Moeara Beting-Krawang (this would have been mangrove forest), Tjibareno, Bandjar, Tegal-Brebes, Djember (all below 300 m), Tjibadak (400 m), Soekaboemi (600 m), etc. It is necessary to state that amongst birds from lowland localities there are several in fully adult plumage, so that the occurrence in the lowlands cannot be dismissed as merely a matter of juvenile dispersal in the post-breeding period. I note that Hoogerwerf (1970: 454), on admittedly very slender evidence, assumed breeding in the lowland reserve of Udjung Kulon. The explanation for the fact that in Java the species has more often been recorded from the higher levels appears to be simply that it is a forest bird and lowland forest in Java is and was already in the first half of this century, extremely scarce. The most one can say is that the bird is perhaps more common at the higher levels (cf. Hoogerwerf l.c.).

Wattel (1973: 40) refers to Sody as evidence that in Java *A. virgatus* occurs in the teak forests; now *Tectona grandis* plantations provide a very open kind of woodland and in Java they are to my knowledge practically confined to the flat lowlands, whereas according to Wattel (admittedly erroneously as pointed out above), the vertical distribution of *A. virgatus* in Java is from 1000-2200 m. Checking the reference given (Sody 1953: 138) I found that the bird was recorded under the name *A. v. gularis* and was moreover clearly stated to have been: "Een exemplaar van het trekkende ras".

Voous's opinion that in the Sunda Islands, within suitable habitat, the species is rare, is also in need of modification. At the time Voous was able to muster only 27 specimens from the Greater and Lesser Sunda Islands combined, but through purchases (mainly of the Bartels collection) and bequests our collection has grown so much that now we have 85 specimens from Java alone. The number of skins of *A. gularis* from Java in our collection is now 62, so that the ratio between the two species has become reversed.

Geographical variation. Wattel (1973: 34-43) divided the subspecies of *A. virgatus* into three groups, the *gularis*-group, the *virgatus*-group and the *affinis*-group. I consider his *gularis*-group to constitute a distinct species, *A. gularis,* not even very close to *A. virgatus.* This leaves Wattel's two other groups: the *virgatus*-group in which he placed the subspecies from the Sunda Islands and the Philippines, as well as *A. v. besra* from southern India and Ceylon, and the *affinis*-group, reserved for *A. v. affinis.* He explained this view with the statement that: "Birds from southern India and Ceylon...are closely similar to the Malaysian races, but this similarity is due to convergence rather than to former geographical contact". My opinion is that this division is artificial. The difference between *A. v. besra* and *A. v. affinis,* assigned to different groups by Wattel, is merely one of size, and everything points to the two being closely related, as indeed one would expect on zoogeographical grounds. In making this unnatural division, Wattel may have been influenced by Hartert (1910: 210-211) and Swann (1921-1922: 61 and 1926: 327), who treated *A. v. besra* as a race of *A. virgatus,* but treated *A. v. affinis* as a separate species under the name of *A. affinis.* On the other hand it is perfectly true that *A. v. besra* as well as *A. v. affinis* are also very close to *A. v. virgatus* and certainly not sufficiently different for these subspecies to be placed in different groups. To me it seems that, if groups have to be made at all, the Philippine subspecies should rather be treated as a separate group. Unfortunately our collection contains only a single specimen from the Philippines (♂ ad., 21-x-1887, Ayala, Mindanao, leg. F. S. Bourne) which is conspicuous by the complete absence of barring on the ventral surface, and by the strong reduction of cross-bars on the tail. I note that Wattel (1973: 42-43) appears to be of the same opinion, as he states: "Apparently *confusus* originated independently whereas *vanbemmeli, virgatus,* and *rufotibialis* had a common origin". In this connection one wonders why, nevertheless, he placed them all in the same group, just as it seems illogical that he treats *besra* throughout as a member of the *virgatus*-group, but ends by saying that the similarity is due to convergence.

The subspecies of *Accipiter virgatus* are the following:

A. v. virgatus (Temminck, 1822): Java, Bali, Flores.
A. v. vanbemmeli Voous, 1950: Sumatra.
A. v. rufotibialis Sharpe, 1887: Borneo.
A. v. besra Jerdon, 1839: Ceylon and southern India.
A. v. affinis Hodgson, 1836: Himalayas to eastern China.
A. v. fuscipectus Mees, 1970: Formosa.
A. v. abdulalii subsp. nov.: Andamans.
A. v. confusus Hartert, 1910: northern Philippines.
A. v. quagga Parkes, 1973: southern Philippines.

The subspecies *A. v. kashmiriensis* Whistler & Kinnear has not been included as it is only doubtfully separable from *A. v. affinis,* under which subspecies a discussion of its validity will be given. It should further be clear that this paper is not a revision and that subspecies will only be treated in as far as they have a bearing on the correct identification of birds from the Andamans. Therefore I have not attempted to study the subspecies from

Sumatra, Borneo, and the Philippines. For a discussion of the former, I refer to Voous (1950), for a discussion of the latter see Parkes (1973: 17-19).

In this paper I am not particularly concerned with historical zoogeography but it will be clear that the apparently wide distribution of *A. virgatus* in the tropical lowlands makes at least debatable Wattel's (1973: 18, also 43) surmise that: "*A. virgatus* probably never had a continuous distribution across the Sunda shelf, because at present it is restricted to hill and mountain country. Therefore, its dispersal must have taken place earlier or was achieved by long-distance colonization. The occurrence of *A. virgatus* on the Andamans and on Flores prove that such long-distance colonizations have occurred...". It is also unclear to me what exactly Wattel means with a dispersal that has taken place earlier; earlier than what?

Accipiter virgatus affinis Hodgson

Accipiter affinis Hodgson, 1836, Bengal Sporting Mag. (n. s.) 8: 179.—Nepal (reference not verified).

Material examined. ♂, undated, before 1862, Nepal, collector unknown (RMNH cat. no. 1, recorded by Schlegel 1862: 33 as *Nisus gularis*); ♂ im., undated, North Bengal, leg. S. Pinwill (BM no. 76.10.20.29); ♂, undated, Darjeeling, leg. J. Fortheringham (BM no. 77.2.20.6); ♀, 1873, Darjeeling, collector unknown (BM no. 85.8.19.681); ♀, xii.1877, Darjeeling, leg. Hume (BM no. 85.8.19.684); ♀ im., undated, Murree, Punjab, leg. J. Biddulph (BM no. 97.12.10.1749); ♀, xii.1910, Sukna, Darjeeling, leg. H. K. Robinson (BM no. 1921.7.12.31); ♀, 8.v.1922, Ranikhet, U.P., leg. F. Field (BM no. 1949 Whl. 1-161); ♀ im., 15.viii.1922, Gulmarg, Kashmir, 9000′, leg. B. B. Osmaston (BM no. 1949 Whl. 1-170); ♀. 9.i.1932, Kangkwa Cliq, Tuiwa Rerame, Katha Distr., Burma, 1100′, leg. H. C. Smith (BM no. 1948.80.3652); ♂ juv., 9.ix.1935, Chilung Pati, Nepal, 9500′, leg. F. M. Bailey (BM no. 1938.7.15.121); ♂, 11.vii.1936, Nyug La, Pachakshiri, S. E. Tibet, 10,000′, leg. F. Ludlow (BM no. 1937.1.17.85); ♀ im., 16.xi.1938; Chungkar, S. E. Bhutan, 6500′, leg. illegible initials (BM no. 1938.12.13.99).

In addition I made use of the list of measurements of material I examined some years ago (Mees 1970: table II).

Distribution. The distribution as ascertained from material examined and from reliable literature records is from Kashmir and the extreme north-east of Pakistan (Murree near Rawalpindi) eastwards along the Himalayas, through Assam, Burma, northern and eastern Thailand, to Indo-China, southern, central (to as far north as the Tsinling mountains, cf. Cheng 1973: 47) and southeastern China. The range does nowhere extend into the Indian Plain. The vertical distribution is considerable, extending from little above sea level to 3000 m (cf. list of material examined, which was collected between 1100′ and 10,000′, or between 330 and 3000 m).

In Burma, *A. v. affinis* is widely distributed; it is obviously a resident on Mt Victoria (Stresemann & Heinrich 1940: 249) and has been recorded from Pegu (BM no. 84.1.30.22, cf. Mees 1970: 288), but I doubt that it occurs in Tenasserim: the eggs collected by Hopwood near Tavoy and listed by Baker (1935: 115-116) under the name *A. gularis nisoides* might be referable to *A. badius* rather than to *A. v. affinis.*

Characters. A large subspecies· wing length of 27 ♂ 159-171, 34 ♀ 190-207 mm.

Discussion. In the discussion of range and movements (see also the section "Is *A. v. affinis* migratory"), *A. v. kashmiriensis* has not been separated from *A. v. affinis*. The former is still a somewhat controversial subspecies. It was accepted by Ripley (1961:47), Ali & Ripley (1968: 246-247) and Abdulali (1969: 704), but rejected by Vaurie (1965: 165), whereas I (Mees 1970) was doubtful of its validity. Wattel (1973) entirely ignored the name, but whether this was because he did not recognize it, or simply overlooked it (as suggested by the fact that in his extensive bibliography the paper in which this subspecies was described is not listed) is not clear. I have no new evidence; anyway, *A. v. kashmiriensis* is at most a weakly differentiated form, continuous in range with *A. v. affinis*, so that it appears entirely justified to treat the two together. It is perhaps relevant to mention that although the subspecific name *kashmiriensis* was bestowed on the western birds, the type-locality is Murree, which is in the Punjab and has never been in Kashmir although it is close to the border. Whistler & Kinnear (1936: 435), writing about *A. v. kashmiriensis*, stated with much confidence: "The birds which appear in winter in the United Provinces belong to this western form". They remained completely silent, however, on which birds exactly they had in mind when making this statement. As mentioned, I have been unable to find any reliable records of winter birds from outside the presumed breeding range.

Incidentally, in dealing with the subspecies *A. v. kashmiriensis* a nice point arises as to whom authorship should be ascribed. The paper which I am citing as being written by Whistler & Kinnear, actually bears on its title page the indication that it is "by Hugh Whistler, assisted by N. B. Kinnear". Even so, both authors would be responsible for this and other new names, but I noted that in the discussions accompanying the descriptions of the new names, invariably the first person singular is used Kinnear's contribution is nowhere made clear.

Accipiter virgatus besra Jerdon

Accipiter besra Jerdon, 1839, Madras J. Litt. Sci. 10: 84.—Soonda Jungles, South India. (reference not verified).

Material from Sri Lanka. ♂, undated, Ceylon, no collector (BM no. 77.5.24.17); ♂, undated, Ceylon, leg. S. Bligh (BM no. 1955.6. N.20.2802, ex Norwich Castle Mus.); ♂, undated, Ceylon, leg. S. Bligh (BM no. 1955.6. N. 20.2803, ex Norwich Castle Mus.); ♀, undated, Ceylon, no collector (BM no. 87.11.1. 242, ex. Coll. Tweeddale); ♂, V. 1894, Coneygar, leg. A. L. Butler (BM no. 1916.9.20.524); ♂, 6.iii.1956, Kalatuwawa, E. of Colombo, leg. E. C. Fernando (BM no. 1956.44.8); ♂, 20.iv.1956, Kalatuwawa, leg. E. C. Fernando (BM no. 1956.44.7); ♂, 23.x.1958, Kalatuwawa, leg. E. C. Fernando (BM no. 1959. 19.1).

Material from India. ♂, 18.xi.1881, Coonoor, Nilghiris, leg. W. Davison (BM no. 85.4.10.1); ♀, undated, Ootacamund, Nilghiris, leg. W. Davison (BM no. Gurney 2795, ex Newcastle Mus.); ♀ im., 18.ix.1901, Ootacamund, Nilghiris, no collector (BM no. 1949 Whl. 1-168); ♀, 10.xi.1939, Biligirirangan Hills, Mysore, ca. 3000′, leg. Sálim Ali (BM no. 1949, Whl. 1-169); ♀ im., 1.i.1956, Bhavnagar, Saurashtra, leg. Dharmakumarsinhji (BNHS no. 20773); ♀ juv. (large nestling or just fledged), 24.v.1956, Perumalmalai, Palni Hills, 5000′, leg. N. A. Fuller & Bro. Novarro (BNHS no. 20016); "♂"=♀, 8.xi.1958, Shembagnur, leg. N. A. Fuller (BNHS no. 20734); sex?=♀, 21.xii.1971, Point Calimere, leg. BNHS party (BNHS no. 23911).

Distribution. Sri Lanka and southern India in forested parts: Palni, Nilghiri and Biligirirangan Hills; along the Western Ghats to as far north as the vicinity of Bombay and perhaps beyond. The bird from Bhavnagar must have been a straggler, the species is unlikely to breed in Saurashtra. Discussing the distribution of this subspecies, Baker (1928: 160) wrote: "there are typical specimens in the British Museum from Mhow". This must refer to specimen BM no. 75.6.24.15, the only sparrow-hawk of the *virgatus/gularis* group from Mhow in the BM collection; although labelled *A. v. besra,* it is *A. gularis* (see further under that species). Very little is known of the occurrence in the easterly regions of India: the older records were summarized by Whistler & Kinnear (1936: 435) and recently a specimen was collected at Point Calimere, as listed above.

Note that the breeding range of *A. v. besra* is widely separated from that of *A. v. affinis* and that the map published by Brown & Amadon (1968: map 37), which shows the two subspecies in broad contact along the Himalayan foothills, is completely misleading.

Characters. This subspecies differs from *A. v. affinis* merely in its smaller size: wing length of 8 ♂ 150-158, 7 ♀ 180-193, against 27 ♂ 159-171, 34 ♀ 190-207 mm in *A. v. affinis* (see table of measurements and Mees 1970; table II). Although there is a slight overlap in measurements, only two out of 34 females of *A. v. affinis* have a wing length of less than 194 mm (190, 191 mm).

I am unable to confirm the existence of consistent colour differences between *A. v. affinis* and *A. v. besra,* which most previous authors claimed (cf. Baker 1928: 159, Ali & Ripley 1968: 248). Admittedly some males from Sri Lanka are conspicuously red on the underparts (BM no. 77.5.24.17 being an extreme in this direction), but other specimens from the same island (cf. BM no. 1916.9.20.524) agree completely in plumage with average *A. v. affinis*. Elsewhere I have commented upon a rather red female of *A. v. affinis* from Tehri (Mees 1970: 291).

Discussion. Swann (1926: 324) gave for *A. v. besra* the following wing measurements: ♂ 165-167, ♀ 188-203 mm; although he correctly mentioned that this subspecies is larger than *A. v. virgatus,* the measurements he presented are much too large. Whistler & Kinnear (1936: 436) provided correct measurements, but erroneously claimed *A. v. besra* to be of the same size as the nominate race. This was repeated by Brown & Amadon (1968: 469), who made no direct comparison between this subspecies and *A. v. affinis,* but stated: "about the same size as the nominate race, but not so richly coloured. Wing ♂ 145-166, ♀ 182-189". These figures were obviously although without reference copied from Baker (1928: 160). The range of variation given for the males is surprisingly large, probably it includes measurements of *A. v. affinis* as Baker mentions under the name *besra:* "two specimens labelled as from North Bengal from the Pinwill Coll. These may be wrongly marked". I have examined one of the Pinwill specimens and see no reason to query its provenance, but of course it is *A. v. affinis.*

Wattel's (1973: 39) diagrams and figures indicate that *A. v. affinis* has a relatively longer tail than birds of his *virgatus*-group (including *A. v. besra*). For *A. v. affinis* he found a tail-length of 78.32% of the wing-length and for the *virgatus*-group this same value was 75.82%. By combining *virgatus* with *besra,* Wattel has, however, marked the fact that in relative length of the tail *A. v. besra* is intermediate between *A. v. affinis* and *A. v. virgatus,* just as it is intermediate in linear measurements. The values found by me for the three subspecies are as follows: *A. v. virgatus* 10 ♂ 73.9%, 10 ♀ 73.3%; *A. v. besra* 8 ♂ 74.7%, 7 ♀ 76.5%; *A. v. affinis* 27 ♂ 76.8%, 33 ♀ 78.0%. For comparison the figures for the largest of all subspecies, *A. v. fuscipectus,* are 12 ♂ 78.2%, 9 ♀ 80.0% (cf. Mees 1970: table I). It looks as if there is a direct relation between general size and relative length of the tail, the larger subspecies having relatively longer tails, but there is no evidence at all of a break between *A. v. besra* and *A. v. affinis,* sufficient to place them in different groups.

The bird from Bhavnagar was first recorded by Dharmakumarsinhji (1956) under the name *A. virgatus*; he did not go into the matter of its subspecific identity. The same bird was again discussed by Abdulali (1969: 704-705), who commented: "The ♀ from Bhavnagar (wing 185, tail 142) which was recorded as *besra* agrees in size with the adult female (by plumage) from the Palnis, but it is a juvenile and much paler in colour and appears to be of a northern race". As explained above, Dharmakumarsinhji did not assign the specimen to a subspecies; he used the name Besra in a vernacular sense only, but I have examined the specimen and do indeed consider that it to belongs to *A. v. besra.* I do not find the bird paler than other specimens of this race and the measurements confirm its identity. Although the bird is immature, it is certainly full grown. Note that Baker (1928: 159 in key) claimed *A. v. besra* to be: "above paler in both sexes at all stages" than *A. v. affinis.* (*A. v. kashmiriensis* had not yet been described at the time and would have been included in *affinis*) and that Ali & Ripley (1968: 249) called *A. v. besra* "much paler" than *A. v. affinis.* As mentioned above, I am unable to see any colour differences between *A. v. affinis* and *A. v. besra,* and as regards colours, the specimen from Bhavnagar fits well into either.

Accipiter virgatus abdulalii subsp. nov.

Material examined. ♂, 25.ii.1964, Betapur, Middle Andaman, leg. H. Abdulali (BNHS no. 21897, type of *A. v. abdulalii*); ♀, 14.iv.1873, South Andaman, leg. W. Davison (BM no. 85.8.19.690); ♀ juv., viii.1875, Andamans, leg. R. J. Wimberley (BM no. 85.8.19.688); ♀ juv., viii.1875, Andamans, leg. R. J. Wimberley (BM no. 85.8.19.689); ♂ juv., ix.1879, Andamans, leg, R. J. Wimberley (BM no. 85.8.19.687); ♀, 25.ii.1964, Betapur, Middle Andaman, leg. H. Abdulali (BNHS no. 21896); ♀, 9.iv.1969, Wrightmyo, South Andaman, leg. H. Abdulali and party (BNHS no. 23111).

Distribution. At present known from Middle Andaman and South Andaman, the two largest islands of the Andaman Group.

Diagnosis. Closest to the continental races *A. v. affinis* and *A. v. besra*; smaller than the former, but in size agreeing with the latter.

The adult male differs conspicuously from *besra* as well as from all other races of the species in the coloration and colour-pattern of the underparts. The breast is greyish tawny, flanks and belly are dull tawny, vent and under tail-coverts are white, and the feathers covering the tibiotarsus are uniform light grey. Apart from on a few axillaries, there is no trace of white cross-bars, or any other barring or pattern, except that the feathers of the breast have the outer margins a trifle darker and greyer than their central parts, giving the breast a faintly scalloped appearance. In the races *besra* and *affinis* cross-bars are always present, if not on the breast, at least on flanks and thighs; the upper breast usually has white in the middle with some dark longitudinal streaks, and the lower breast has a white median longitudinal streak; moreover although there is some variation in colour of the breast, not a single specimen has the greyish tawny colour of the Andaman bird.

Adult females are similar to females of *besra*, except that the bill appears to be a little larger, with especially the ridge of the culmen broader, less sharp. In addition the three Andaman birds have the cross-bars on the under surface a little broader and less sharply defined, and have the barring of the feathers covering the tibiotarsus weaker, than the four specimens of *besra* with which they were compared, but the variation found in males and in other races suggests that individual variation would cover these differences if sufficiently large material were available.

Discussion. The description of *A. v. abdulalii* of which females and juveniles have been in collections for over a century, was made possible by the discovery of an adult male. It is with real pleasure that I dedicate this subspecies to the collector of this specimen, Mr. Humayun Abdulali, who has made such outstanding contributions to ornithological knowledge of the Andaman and Nicobar Islands.

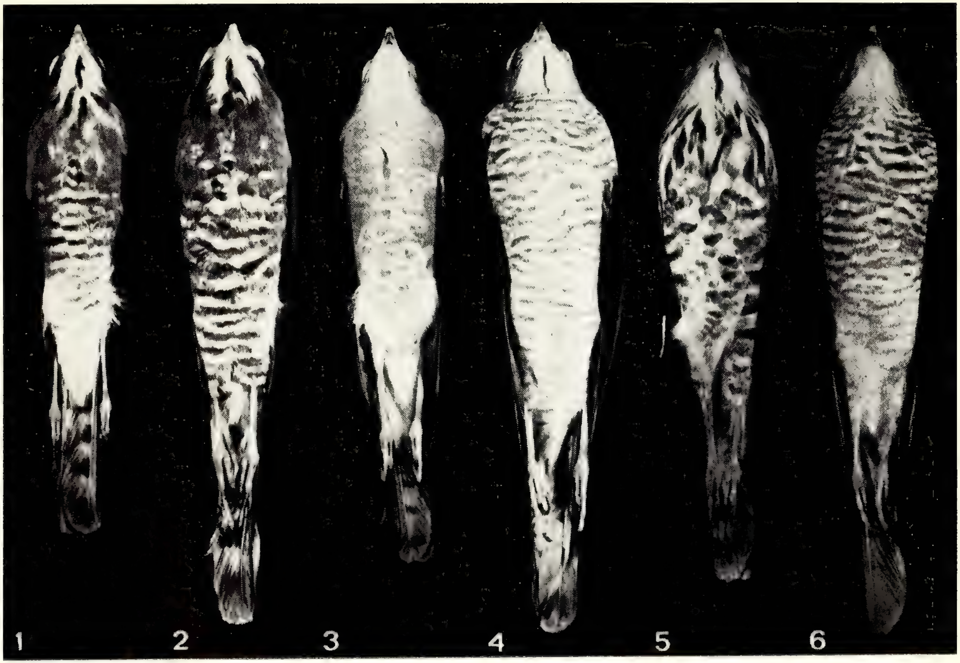
Whether my statement that this subspecies agrees in size with *A. v. besra* is entirely correct, remains uncertain as long as only one adult male of *A. v. abdulalii* is known. Actually the two males of this race are a little smaller than any of *A. v. besra* I have examined, but then the juvenile male (wing 145 mm) is perhaps not quite full grown and that may also have influenced the figure for the sexual difference in wing length (males 80% of females, against 82.7-84% in the other races).

ACCIPITER GULARIS (TEMMINCK & SCHLEGEL)

Characters. The two subspecies of which this species consists are in several respects so different that it is difficult to supply diagnostic characters covering both. As *A. g. iwasakii* is confined to two small islands in the Riu Kius, where it is known to be sedentary, whereas the nominate race is widely distributed and, being strongly migratory, in its winter quarters with which this paper deals is frequently confused with other species, I shall give here the diagnostic characters of *A. g. gularis* only.

Sexual difference in size is considerable, but not so great as in *A. virgatus*. Sexual dimorphism in plumage remarkable: the adult female plumage is quite unlike that of the male, or than that of any of the other small species here treated, in that the underparts with the exception of the white throat, are densely barred with dull brown on a white background. Wings pointed, wing tip in males 49-56, in females 55-66 mm, or *c*. 30-32% of wing length. Under wing strongly barred. Tail relatively short. Dark median streak on the white throat variable, almost absent in some specimens, distinct in others, a variation that shows no obvious relation with age or sex.

In the immature plumage this species may be distinguished from *A. virgatus* in having the underparts less strongly marked. In *A. virgatus* the spots are strong on the lower abdomen, where they are less conspicuous or almost absent in most specimens of *A. gularis*. Moreover, in the former the markings are usually darker, and provided with rusty



(1) *A. v. virgatus* ♂ ad.; (2) *A. v. virgatus* ♀ ad.; (3) *A. g. gularis* ♂ ad.; (4) *A. g. gularis* ♀ ad.; (5) *A. g. gularis* ♀ im.; (6) *A. g. gularis* ♀ ad. The nos. 5 and 6 show the opposite extremes in development of the gular stripe as found in a large series.

edgings; the sides of the breast are tinged with rust colour. In *A. gularis*, on the other hand, all markings are of a uniform and rather dull brown.

Habitat. The nominate race is in summer an inhabitant of mixed forests and deciduous forests of the cool-temperate region. In the winter quarters it is found in all kinds of semi-open and wooded country, not only in the lowlands, but also at higher elevations. Material in our collection is singularly devoid of indications of altitude, although some of the localities of collecting are suggestive even without them. In Java, Hoogerwerf (1948: 123) considered it to occur at all levels, but rare or absent above 2500 m. The habitat of *A. g. iwasakii* will be discussed separately.

Geographical variation. There are two well-marked subspecies, the widely distributed *A. g. gularis* and the insular *A. g. iwasakii*, confined to two small islands in the Riu Kius. The two are so different that a strong case could be made for the view that they are distinct species, see the discussion of *A. g. iwasakii* given on a later page.

In the literature one frequently finds reference to *Accipiter stevensoni* Gurney (1863), a name based on two specimens: one from Macao and one from Tientsin (rather than Peking). In the original description no mention is made of *A. gularis*, with which evidently it was not compared. Later authors have usually regarded the name as a synonym of *A. gularis* (cf. Ogilvie-Grant 1896, Hartert 1914: 1161, etc.), but from time to time attempts have been made to recognize it as a subspecies. Apparently Baker (1928: 163) was the first to revive it, in the combination *A. gularis stevensoni;* compared with *A. g. gularis* he claimed it to be: "distinctly paler, both in the male and the female, most noticeably on the lower plumage". This was accepted by La Touche (1932: 195) and with some doubt by Peters (1931: 223), who introduced the trinomial *A. virgatus stevensoni*. Note that the breeding ranges given by the mentioned authors for the two alleged subspecies are more or less the same; for *A. v. gularis* it is: "northern China and Japan", for *A. v. stevensoni*: 'Manchuria to northern China"; note also that there is no mention of the main breeding range of *A. gularis*, which is in Siberia. Voous (1950: 97) stated: "I am of the opinion that the Chinese breeding birds ...must be recognized as a separate race (*stevensoni* Gurney, 1863) from the Japanese form (*gularis* Temminck & Schlegel, 1844) on account of the conspicuous paleness of the underparts in males [2 breeding males from Kwantung (Berlin Museum) and one from Shantung (Leiden Museum) examined]. Females do not seem to be different. In the series of wintering males from Malaysia the two types of coloration are apparent, hence the pale males are supposed to originate from China (or Manchuria) and are tentatively referred by me to *A. v. stevensoni*. The male type specimen of *Astur* (*Nisus*) *gularis* Temminck & Schlegel from Japan was examined in the Leiden Museum; it has rather dark rufous brown under parts". In this long quotation there is a lot that requires elucidation. Firstly, it is obvious that the types of *A. stevensoni* must have been migrants as *A. gularis* is not known to breed in China proper. To the "breeding males" from Kwangtung and Shantung on which Voous based his opinion the same pertains. The Shantung specimen is a mounted bird in our old collection from Chefoo, May 1873 (without exact date), leg. R. Swinhoe, received under the name *A. stevensonii*, an identification presumably made by its collector. Swinhoe (1874: 432) himself regarded at least the great majority of the birds as migrants from Korea and Manchuria, although he left open the possibility of occasional breeding near Chefoo (for which he was unable to produce any evidence). Subsequent observations, summarized by LeFevre (1962: 31) have confirmed that *A. gularis* does not breed near Chefoo. I would not describe the underparts of the male type specimen of *A. gularis* (RMNH cat. no. 1) as "rather dark rufous brown"; actually they are only a trifle richer in colour, particularly on the sides of the breast, than in the Chefoo specimen and both fit well in the not overlarge range of variation found in material from the winter quarters. When Voous wrote his article, the presence of a breeding population in Japan had still to be confirmed; although now this confirmation has been obtained, it is probably more common as a migrant, and whether the type-specimens of *A. gularis* belonged to a resident population is anybody's guess. Probability is against it. None of the authors who recognized *stevensoni* could have examined the beautiful coloured plate accompanying the description of *A. stevensoni*, for it shows a bird which certainly is very rich rufous underneath, of a far deeper, not paler, colour than the male type of *A. gularis*.[3] The only species with which *A. stevensoni* was actually compared in its original description, is *A. rhodogaster*. Gurney (1863) remarked that the colouring of the breast was much paler in *A. stevensoni* than in *A. rhodogaster* and in the minds of subsequent workers this remark may somehow have become transposed to *A. gularis*, leading to the belief that *A. stevensoni* was a particularly pale bird. As already mentioned above, the individual variation in colour of the underparts in specimens collected in the winter quarters is not large, and there is no evidence of bimodality in this variation which would be suggestive of different subspecies. It is true that from this generalization one specimen has to be excluded: ♂ ad., 12.ii.1917, Batoetoelis near Buitenzorg (RMNH cat. no. 53); this bird has the underparts a deep cinnamon, practically unbarred; in the colour of its undersurface it is extremely similar to adult females of *A. soloensis*. Evidently the question as to whether or not the populations of *A. gularis* from continental Asia and Japan show any geographical variation can only be answered when identified breeding birds are compared.

It is true that according to Stepanyan (1959) birds from the western part of the breeding range show a clinal tendency to larger size, whereas in females the cross-bars on the under surface would be a little narrower and wider apart. In my opinion these average differences hardly justify recognition of a separate subspecies (*A. virgatus sibiricus* Stepanyan) and in the winter quarters even the distinction of extreme individuals would be practically impossible. For this reason I have not further considered the name *sibiricus*.

Discussion. Whether or not *A. virgatus* and *A. gularis* are conspecific is still a point of controversy in literature. Following Stresemann (1923), in a majority of recent publications *gularis* has been treated as a subspecies of *virgatus*, but Vaurie (1965: 165 footnote) stated: 'This hawk is often considered to be conspecific with *A. virgatus* but it is very distinct from it morphologically and appears to be a distinct species related to *A. virgatus* and *A. nisus*". The breeding range of *A. gularis* as circumscribed by Vaurie overlaps extensively with that of *A. virgatus* in southern China (Kwangtung, Kwangsi) and Formosa, and this may have contributed to his decision to treat them as different species (cf. Mees 1970: 291, Wattel 1972: 27 and 1973: 42). Since then it has, however, become evident that the records on which this was based concern migrants and that in fact the breeding ranges of *A. virgatus* and *A. gularis* are widely separated, except for the peculiar occurrence of an endemic subspecies *A. gularis iwasakii* on the two southernmost Riu Kiu Islands (Ishigaki and Iriomote), adjacent to Formosa where *A. virgatus fuscipectus* lives. As a consequence, I considered the problem of the status of *A. gularis* to be open to discussion again, and I considered it prudent not to take a definite stand either way.

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[3] Surprisingly, the specimen from Paking/Tientsin kept as type (BM no. 1955.6.N.20.2763, cf. Warren 1966: 282), which one would presume to be the figured bird, actually is rather pale, slightly paler than the three males from Japan in the BM collection, and shows other differences from the plate. It is not clear what has happened (Galbraith, *in litt.*, 4.vi.1979).

In the course of studying *A. g. gularis* I have, like Vaurie and others before me, become increasingly impressed by the differences it shows from *A. virgatus*. These include the considerable sexual dimorphism in plumage, the smaller sexual difference in size, the shape of the wing, the relatively shorter tail, the somewhat smaller bill, the relatively shorter tarsus. Apart from morphological differences, ecological differences deserve also to be taken into consideration: *A. gularis* appears to inhabit (certainly in its winter quarters) a more open habitat than *A. virgatus;* whereas the latter is a sedentary inhabitant of tropical forests, where admittedly it ranges into the cooler montane zones, the former is as a breeding bird confined to the temperate regions, and is strongly migratory. All this led me to the conclusion that the relationship between *A. virgatus* and *A. gularis* is far more remote than most recent authors believe it to be; it is not only that I regard them as different species, but I am not even convinced that they are particularly close to each other. Thus my views came to be very close to those of Ogilvie-Grant (1896: 105), expressed eighty years earlier, and quite different from those of Stresemann (1923) whose article has strongly influenced later workers but was rather superficial.

In the above summary of characters distinguishing *A. gularis* from *A. virgatus,* the form *A. g. iwasakii* has been left out on purpose, for it completely spoils the picture. It shows no sexual dimorphism in plumage, the shape of the wing is similar to that of *A. virgatus,* bill and tarsus appear to be larger than in *A. g. gularis*. Ecologically it agrees with *A. virgatus* in that it is a sedentary inhabitant of a humid near-tropical habitat (cf. tables giving temperature, humidity and precipitation on Ishigaki, published by Hachisuka & Udagawa 1953: 146). Here we come on the old problem of which characters are indicative of true relationship, and which ones are merely due to convergence. On the other hand a hopeful point is that the adult plumage of *A. g. iwasakii* is similar to the female plumage of *A. gularis,* and shows no resemblance whatsoever to that of *A. virgatus*. There is, of course, no need to point out here that the fact that characters are adaptive, does not necessarily invalidate them for studies of relationships as it can safely be argued that all characters are adaptive and some, like wing-shape, are only more obviously so than others. All characters add to the general distinctiveness of a form and may contribute to a judgement about its status in relation to other forms. More about the systematic position of *A. g. iwasakii* will be said in the discussion of that subspecies.

In the evaluation of the specific diversity of *A. virgatus* and *A. gularis* account should also be taken of the fact that in the only area where their ranges approach each other closely and under rather similar climatological conditions: Formosa and the southern Riu Kiu Islands, the two most diverse subspecies of each occur. Formosa is inhabited *A. v. fuscipectus*, largest member of the species *A. virgatus*, and the southern Riu Kiu Islands are inhabited by the smallest subspecies *A. g. iwasakii*, which is roughly of the size of *A. v. besra*, and much smaller than adjacent *A. v. fuscipectus*.

Wattel (1973: 43), who treated *A. virgatus* and *A. gularis* as conspecific, speculated: "The distribution and the habitat of *gularis* point to an Oriental origin. After having become isolated in the Himalayas and adjacent mountains, the ancestors of *A. virgatus* recolonized the eastern parts of the Palearctic and differentiated into the present form *gularis*. This may have happened during one of the earlier Pleistocene interglacials. Several other Oriental birds of prey penetrate the eastern Palearctic in a similar way...". In this quotation there is one point I do not understand, and that is why the habitat of *A. gularis* should point to an Oriental origin. As regards Wattel's speculation about the origin of *A. gularis*, it will be evident that this can only be valid when one assumes that *A. gularis* and *A. virgatus* are closely related and that the former is an offshoot of the latter. But it is exactly this assumption which I believe to be highly questionable.

Accipiter gularis gularis (Temminck & Schlegel)

Astur (*Nisus*) *gularis* Temminck & Schlegel, 1844, Fauna Japonica, Aves: 5, pl. II—Japon.

Material from the Andamans. ♂ im., 14.ii.1964, Wimberleyganj, South Andaman, leg. H. Abdulali (BNHS no. 21895).

Material from the Nicobars. ♀, 27.iii.1966, Camorta, leg. H. Abdulali (BNHS no. 22581).

Material from Continental India. Sex not recorded (= ♀ im.), undated, Mhow, *ex* coll. Whitely (BM no. 75.6.24.15); ♂, 16.x.1971, Point Calimere, leg. BNHS party (BNHS no. 23926); sex not recorded (= ♀ im.), undated, Point Calimere, leg. BNHS party (BNHS no. 23700).

Distribution in India. Hitherto *A. gularis* had only been recorded from the Andamans and Nicobars. Salomonsen (1953) published details of a specimen captured at sea in the Bay of Bengal, *c.* 10°N., 90°E., 250-300 km W. of Little Andaman, in the same general area. The specimens listed here constitute the first records from Continental India and their collecting localities indicate that this species may perhaps be found as a scarce winter visitor throughout India. Some caution is, however, necessary in the case of the specimen from Mhow as it has no original collector's label and bears no date; it was provided by Whitely who was a taxidermist and trader (cf. Sharpe 1906: 510). Therefore it seems to me that the provenance Mhow given on its label is not entirely above suspicion.

Distribution. As a breeding bird this subspecies appears to be confined to the temperate regions of Central and East Asia. For its distribution in the Soviet Union see Flint *et al.* (1968: map 52) and for its whole breeding range Wattel (1973: map 4). In the eastern part of its breeding range it seems to be uncommon; in Korea it is described as a scarce summer visitor (Gore & Won 1971: 163). Until recently, breeding in Japan was considered to be very doubtful (Austin & Kuroda 1953: 376), and Wattel still provided the whole of Japan with a great query, but there are now breeding records from all three main islands: Hokkaido, Honshu and Shikoku (Ornithological Society of Japan 1975: 67).

The distributional map published by Cheng (1976: fig. 68) illustrates clearly how wide the geographical gap is in China between the breeding ranges of *A. gularis* and *A. virgatus,* the former being almost confined to Manchuria. This is confirmed by other literature, for example Shaw (1936: 234), who as far north as Hopei knew *A. gularis* as a migrant visitor only, passing through in May and September-October. It is true that Fu (1937: 38) claimed breeding in the mountains of Fou-Niou and Son-Chan in Honan, but from the context it is not clear that he has considered the possibility that the nests could have belonged to *A. soloensis,* a species that ought to occur in Honan but is not mentioned by Fu.

It has been assumed by a majority of authors that *A. gularis* occurs as a breeding bird throughout eastern China, to as far south as Kwangtung, Kwangsi and Formosa (Vaurie 1965: 165, Brown & Amadon 1968: 468 and map 37, Etchécopar & Hüe 1978: 150), where it was supposed to co-exist with races of *A. virgatus.* The matter was discussed in considerable detail by Wattel (1973: 42), who concluded that all records of breeding in southern and eastern China are based on late migrants and on misidentification. Previously I had postulated the same for Formosa (Mees 1970: 291). Cheng's map supports this.

A. g. gularis is strongly migratory, occurring in winter in some numbers to as far south as Sumatra with its satellite islands, Java and the Lesser Sunda Islands (Flores, Timor). Unlike *A. soloensis* it does not go far east; it has only once been recorded from the Celebes and is unknown from the Moluccas.

Discussion. The fact that breeding records from the Andamans are due to confusion with *A. virgatus abdulalii* has been made clear on a preceding page. Ali & Ripley (1968: 250) further wrote under the heading *A. virgatus gularis*: "Occurs in the Nicobars; probably breeding, but status unconfirmed". The specimen listed here is the only one known from the Nicobars (Abdulali 1967: 155). Note in this connexion that Brown & Amadon (1968: 523) make under *A. butleri* the following statement: "The only small sparrow-hawk occurring in the Nicobars, hence unmistakable"; this is misleading as actually three species of similar size are now known from the group (*A. butleri, A. gularis* and *A. soloensis*). Admittedly *A. butleri* is the only resident but evidence is that in winter it is outnumbered by *A. soloensis* and perhaps also by *A. gularis.* Moreover the two migrant species may be expected to occur on all islands of the group whereas on present evidence *A. butleri* is confined to Car Nicobar and Katchal.

Brown & Amadon (1968: 468) gave for *A. gularis,* with which the nominate subspecies is meant (they overlooked *A. g. iwasakii*) a wing length of ♂ 160-187, ♀ 167-198 mm (numbers of specimens not mentioned). The measurements taken by me show a much smaller variation of each sex but a much more pronounced difference in size between the sexes (see tables I and II). The figures published by Hartert (1914: 1162): 24 ♂ 164-171, 15 ♀ 184-195, by Swann (1926: 329): ♂ 163-170, ♀ 184-200 mm (numbers of specimens not recorded), by Voous (1950: 97): 15 ♂ 159-172, 21 ♀ 180-197 mm, and by Wattel (1973: 37 tab. 14): 32 ♂ 158-174 (average 165.9), 21 ♀ 180-197 (average 189.1) mm, agree with mine.

I must assume that Brown & Amadon have measured a large number of wrongly sexed specimens. Their tail lengths show a similar over-large range of variation: ♂ 117-137, ♀ 111-143 mm.

A combination of the dated material in Leiden and Bombay shows that this species begins to arrive in its winter quarters in October and stays until late April and early May.

MONTH	VIII	IX	X	XI	XII	I	II	III	IV	V
RMNH	—	—	6	10	10	8	9	10	4	2
			1				1	1		

The earliest autumn date is 4.x.1921 (Pangerango, Java, leg. Bartels, RMNH cat. no. 58), the latest spring dates are 9.v.1925 (Rembang, Java, leg. Sody, RMNH cat. no. 30), May 1912 without exact date (Medan, Sumatra, leg. de Bussy, RMNH cat. no. 21). The four birds collected in April are from 16, 18, 21 and 23 of that month (all Java). Compare this with the data from the Malay Peninsula, summarized by Medway & Wells (1976: 107).

Voous (1950: 106), who considered *A. gularis* and *A. virgatus* to be conspecific, made in the discussion of *A. gularis* the enigmatic statement: "These birds are less closely related to the Malaysian breeding birds than are the Philippine and Burmese races. They are probably rather close relatives of the North American Sharp-shinned Hawk (*Accipiter velox*), whereas the S. E. Asiatic breeding birds represent a more primitive stage". The suggested relationship between *A. gularis* and *A. striatus* (of which *velox* is a subspecies) has already been discussed and rejected by Wattel (1973: 114), so that there is no need for me to cover that ground again, but what I do not understand in the quotation from Voous given above, and nevertheless read in it, is that the form he calls *A. virgatus gularis*, and therefore regards as a subspecies of *A. virgatus*, would be more closely related to *A. velox* than to *A. v. virgatus*. Surely there is a contradiction here between the opinion he airs and the nomenclature he uses? I also fail to understand why *A. virgatus*, a specialized bird hunter of the tropical forest, should be called 'primitive", a word that without a lot of explanation is meaningless.

Accipiter gularis iwasakii Mishima

Accipiter virgatus iwasakii Mishima, 1962, Tori 17: 219--Ishigaki and Iriomote, southern Riu Kius.

Material. ♂ ad. (originally mis-sexed as ♀), 28.v.1904, Omoto-Dake, Ishigaki, leg. Owston's Japanese collector (AMNH no. 533881); ♀ ad., 6.vi.1904, Kawara-yama, Ishigaki, same source (AMNH no. 533880).

Distribution. Endemic to Ishigaki and Iriomote, southern Riu Kiu Islands.

Characters. Sexual difference in size about the same as in *A. g. gularis*, but contrary to that form there is little or no sexual difference in plumage: the adults of both sexes have a plumage very similar to that of female *A. g. gularis*, but the cross-bars on the undersurface are a little paler, greyer, less brownish. Wings shorter and more rounded than those of *A. g. gularis*, resembling in shape those of *A. virgatus*, as is also clear from the length of the wing tip (see table). Tail not shorter than in *A. g. gularis*, and the feet, if anything, appear to be a trifle heavier than in that subspecies. Viewed from above, the female has six bands on the tail, of which four are free, one is partially visible behind the upper tail-coverts, and one is entirely concealed. All specimens of *A. g. gularis* which I examined for this character have five bands. Dark mesial streak on throat as in the nominate race.

Habitat. To my knowledge no field notes have ever been published, but from its morphology and its localities of collecting it may be safely deduced that *A. g. iwasakii* is a forest bird.

Discussion. The knowledge that *A. gularis* has a resident population on Ishigaki dates from Bangs (1901: 263), who recorded a downy nestling collected on 27.vi.1899. The information about breeding was repeated by Hartert (1914: 1162), who, without referring to Bangs, wrote: "Auf der Insel Ischigaki (südliche Riu-Kiu-Gruppe) brütet diese Art und ist dort Standvogel; ein ♀ hat den Flügel nur 183, 3 alte ♂ nur 160-165 mm, auch sind letztere unterseits sehr stark gebändert; vermutlich handelt es sich um eine Unterart, aber einzelne Zugvögel aus den Tropen kommen dieser Form so nahe, dass sie nach dem Vorliegenden Material nicht zu benennen ist". Hartert failed to state on what his opinion that *A. gularis* was a resident on Ishigaki was based, but probably he combined the breeding record published by Bangs with the fact that specimens had been collected in various seasons. In all subsequent literature, the occurrence of *A. gularis* as a resident in the southern Riu Kiu Islands has been accepted and therefore it is surprising that no further study of this isolated population was made for another fifty years when finally Mishima (1962) described it as a separate subspecies. Although this subspecies was accepted by such critical authors as Wattel (1973: 37), Morioka (1974) and the Ornithological Society of Japan (1975: 67), I am unaware that it has been either observed in the field or studied in the museum since its description.

The fact that zoogeographically an endemic subspecies of *A. gularis* on Ishigaki and Iriomote is unexpected, made me wonder if the evidence was really as strong as it seemed. The most convincing piece of evidence would clearly be the downy nestling: if it was correctly identified, it would provide unassailable proof. As Bangs (l. c.) is singularly uninformative about how the nestling was identified, and whether it was actually associated with an adult bird, it seemed worth enquiring with the Museum of Comparative Zoölogy. Dr. Paynter was so kind to re-examine the specimen for me; he reported that it is definitely an *Accipiter*, but that it is too young for specific identification; indeed, somebody had provided the name *A. gularis* given on the label with a great query. However, as no other species of sparrow-hawk is known to occur in the Riu Kiu Islands, it may safely be assumed that the pullus actually is *A. g. iwasakii*. Anyway, all my doubts ended when I got an opportunity to examine specimens from Ishigaki.

The evidence for the occurrence on Iriomote, poorly documented in the consulted literature, rests on an adult female and a downy young in the Yamashina Institute, collected together on 5.vii.1936 (Yamashina, *in litt.*, 7.vi.1979).

Small as the sample of *A. g. iwasakii* was, it shows some conspicuous differences in proportions from the nominate race (see table). Previous authors (Hartert) have noted that it is a trifle smaller, but also the tail is relatively longer. It seemed of interest to investigate whether the tail is actually longer, or that the difference is due to the wings of *A. g. iwasakii* being relatively shorter. For the sake of convenience I compared specimen BNHS no. 22581 of *A. g. gularis* with specimen AMNH no. 533880 of *A. g. iwasakii*, both of which have a tail of 132 mm, but the wing length of the first specimen is 192 mm, that of the second specimen 181 mm, resulting in a tail/wing index of 68.8% in the former, 72.9% in the latter. However, if we take off the wing tip (58 mm in the first specimen against 46½ mm in the second), the remaining wing length of the first specimen is 192 - 58 = 134 mm, of the second 181 - 46½ = 134½ mm, hence virtually identical. This strongly suggests, not unexpectedly, that the shift in wing/tail ratio between the two subspecies is due to the shorter more rounded wing of *A. g. iwasakii*. This also shows that the structural differences between the two subspecies are not, after all, so very great. The more rounded wing of *A. g. iwasakii* is an adaptation to a sedentary way of life, of a kind common to many species of birds and therefore of limited phylogenetic significance. However, as I have stressed on a previous page, it is of some significance. It will certainly have taken *A. g. gularis* and *A. g. iwasakii* many generations to have become as different in wing shape as they are now. There is always a temptation to use certain characters when they happen to fit into one's theories, and to reject them as insignificant when they do not. Although it is perhaps no longer fair to criticize a paper over fifty years after its publication, it is still relevant to the problem here discussed to recall that Stresemann (1923: 517) used the agreement in wing formula between *A. soloensis* and *A. brevipes* as evidence for their close relationship, and proceeded to call a difference in wing formula "ein unwesentliches Merkmal", to be able to unite both with *A. badius*.

As will be clear from the discussion given above, I started off with a strong mistrust of this form, the main reasons for this being that *A. g. gularis* is known to be a late migrant so that specimens collected in late May and early June could still have been on their way back to the breeding grounds in eastern Siberia, that the islands Ishigaki and Iriomote are not only remote from the breeding range of *A. g. gularis* but also far more southerly, and that one would not expect an endemic form on these two islands but absent from the larger central group of the Riu Kius. All these prejudices proved mistaken when I examined material, for actually *A. g. iwasakii* is far more distinctive than literature had made me believe. Although Hartert (as quoted above) noted the cross-bars of a male bird, Mishima's (1962) description is based on wing formula and size only; no mention is made in it of colour characters and of the wing tip. Its geographical, morphological and colour characters combined, make *A. g. iwasakii* about as distinct from *A. g. gularis* as *A. butleri* is from *A. badius*. *A. g. iwasakii* and *A. butleri* have, through convergence, several points in common: both are strongly modified isolates, confined to a few small islands, both have shorter and more rounded wings as well as somewhat larger and heavier bill and feet than the species from which they are assumed to have been derived, perhaps both lack sexual dimorphism in the adult plumage (I have not examined *A. butleri*, but in the literature only one adult plumage has been described). Since *A. butleri* is nowadays usually treated as a separate species, although there is agreement that it has been derived from *A. badius*, it would be consistent to treat *A. g. iwasakii* also as a species rather than as a subspecies of *A. gularis*. I have not done so because, in spite of the differences, there is a lot of agreement between *A. g. gularis* and *A. g. iwasakii* in general proportions, plumage of the female, etc., but mainly because, whatever its exact status, *A. g. iwasakii* is clearly a derivative of *A. gularis*, and in the framework of this paper it is convenient to express this relationship in nomenclature. As regards its true status, which must remain speculative anyway, I would be inclined to regard it as a separate species.

According to Wattel (1973: 43): "The occurrence of a population on the southern Riu Kiu Islands which is most closely similar to Palaearctic *gularis* can be understood by supposing that a group of migrants of the northern form settled in these islands". It is perfectly possible that this interpretation is correct, but *A. g. iwasakii* could equally well be a glacial relict, dating from a period that the main range of *A. gularis* was farther south than at present. In either case, its morphological peculiarities prove that *A. g. iwasakii* has been isolated for a long time.

ACCIPITER BADIUS (GMELIN)

Material examined. Small series of the subspecies *A. b. badius, A. b. dussumieri* and *A. b. poliopsis*. The available specimens of *A. b. dussumieri* were nearly all from our old mounted collection, without other data than vague indications of provenance: "Inde", "Hindoustan", "Bengale".

Distribution. Aethiopian Africa, southern and south-eastern Asia. In Asia ranging from eastern Transcaucasia right across to southern China. Occurs in Sri Lanka, but not in the islands to the south-east and east of the Asiatic mainland, except as an uncommon migrant to Formosa and Sumatra. In India generally distributed throughout the lowlands and the lower montane regions with an upper limit of *c.* 1500 m in India (Ali & Ripley 1968: 236), or at least 1800 m in Ceylon (Whistler 1944: 249).

Characters. The distinctive characters of this species (all subspecies occurring in south-eastern Asia) can be summarized as follows. Differs from *A. virgatus* by its much more pointed wings; wing tip in males 50-63 mm, in females 58-65 mm, against 35-43 mm in males and 41-52 mm in females of *A. virgatus* from India (three subspecies combined). From *A. gularis* this species differs in all plumages by having, sex for sex, longer wings although there might be marginal overlap in large series; by having larger and heavier bill and claws, and a conspicuously longer tail.

Adult specimens of either sex rarely cause identification problems. The comparatively light grey upperparts, the absence of distinct bands on the central rectrices, apart from a subterminal one, and the pattern of cross-bars on the breast are quite distinctive. Only in the last-mentioned character is there some variation that might lead to misidentification. Usually the cross-bars are vivid brown, close together, but in some specimens they tend to be less marked and more pinkish in colour, and such specimens can show a superficial resemblance to certain adult males of *A. gularis* (but the back and tail pattern are always different).

Geographical variation. In southern and eastern Asia the following subspecies are currently recognized: *A. b. cenchroides* (south-western Asia eastwards to northern Pakistan), *A. b. dussumieri* (the greater part of India), *A. b. badius* (Sri Lanka, and perhaps the extreme south of India), and *A. b. poliopsis* (from Assam and Burma eastwards). The position of the populations in southern India has not been definitely settled; usually they have been referred to *A. b. badius*, but Whistler (1944: 248) observed: "Travancore birds are really intermediate between *badius* and *dussumieri* but on the whole it is best to include them with the former", whereas according to Abdulali (1969: 701) they agree better with *A. b. dussumieri*. At least some of the subspecies are migratory: *A. b. cenchroides* has been recorded in winter from north-western India (Ali & Ripley 1968: 235) and Bombay (Abdulali 1969: 700), whereas *A. b. poliopsis* is a scarce winter visitor to the northern Malay Peninsula (Medway & Wells 1976: 105) and reaches Sumatra from where three specimens are known (cf. Junge 1948: 319), all three of which I have examined. I have not studied the geographical variation of *A. badius*, being concerned with its specific characters only, but further study at the subspecific level might be rewarding.

Discussion. *A. badius* had to be included in this paper as in its immature plumage it has so often been confused with *A. virgatus* and *A. gularis*. The synonymy given by Deignan (1945: 63-64), for example, shows that in northern Thailand alone, *A. badius* has been recorded under the names *A. gularis*, *A. trivirgatus indicus* (!), *A. gularis nisoides* and *A. virgatus nisoides*. In continental India also, this species has been consistently confused with *A. virgatus*.

ACCIPITER SOLOENSIS (HORSFIELD)

Falco Soloënsis Horsfield, 1821, Trans. Linn. Soc. Lond. 13: 137—Java (by inference Solo).

Material from the Nicobars. ♀ juv., 25.ii.1858, Car Nicobar, leg. J. Zelebor, Novara Exp. (MV no. 71222).

Distribution in India. Known as a winter visitor to the Nicobars. Records from the Andamans are erroneous (see Discussion).

Distribution. As a breeding bird known from Korea, where it is common and widely distributed (Gore & Won 1971: 160-163), and the greater part of China, west to Szechwan, south to Kwangtung. In view of the common occurrence in Korea and the fact that this species has even been found in Russian teritory (Labzyuk *et al.* 1971: 58, Nazarov & Labzyuk 1975: 271) the map in Cheng (1976: fig. 65) in which it is shown as confined to the southern half of China appears too restrictive, although it is true that there is no actual proof yet of breeding in northern China and Manchuria and that the number of records is surprisingly small. Supposed breeding in Formosa (Hachisuka & Udagawa 1951: 97, Vaurie 1965: 164) remains unconfirmed (cf. Mees 1970: 286, Wattel 1973: 30). Strongly migratory and in winter found to the limits of an arc extending from the Nicobars in the west, over the Greater and Lesser Sunda Islands and the North Moluccas, to islands off the western tip of New Guinea.

Characters. Of the species here dealt with, *A. soloensis* is the least likely to cause confusion. It is characterized by having little sexual dimorphism, either in size or in plumage, a very long wing tip (the difference between the longest primary and the tenth being 68-75 mm, or 35.6-38.8% of the wing length in 21 specimens), a comparatively short middle toe, and in the adult plumage an underwing pattern almost devoid of barring: seen from below the outer primaries are dark grey or black, the remainder of the wing is white or pale buffish, with at most a few dark spots. All other species here dealt with have the primaries and much of the underwing distinctly barred. There are a few thin grey lines on the white throat, often forming a narrow dark median stripe.

Sexual dimorphism in plumage is comparatively slight, but is not entirely absent. Adult females have the chest, lower chest and flanks a rich cinnamon. Some adult males come near them, but most males have the underparts conspicuously paler, more pinkish.

Discussion. A. soloensis was recorded from the Andamans by Ripley (1961: 46), Ali & Ripley (1968: 239-240) and finally by Wattel (1973: 30) but apparently mistakenly (see also Abdulali 1969: 702). The error originated probably with Baker (1928: 153) who did not include the Andamans in the range as given under the heading 'Distribution', but under 'Habits' observed: "Hume saw it in the densest forests in the Andamans". In the published works of Hume I have been unable to find any evidence that he ever observed *A. soloensis* in the Andamans, nor, indeed, in the Nicobars (cf. Hume 1874: 141) and I suspect that Baker has misquoted Hume's remarks about the specimen collected in the Nicobars by Zelebor of the Novara expedition.

In the Nicobars, *A. soloensis* has long been known. A specimen was collected on Car Nicobar as long ago as February 1858 and was reported in print a few years later (cf. Pelzeln 1865: 12). It is true that Richmond (1902: 307) questioned the identification of the specimen, an immature female, and speculated that it belonged to *A. butleri,* a species not yet described when Pelzeln's paper was published. Other authors have copied this. Since the point had to my knowledge never been verified, I reexamined the specimen and found that its original identification was perfectly correct. Why Richmond should have doubted this is not clear anyway as he himself recorded a series of no fewer than twelve specimens of *A. soloensis* taken on Katchal, Great and Little Nicobar. Dr. Watson has been so kind as to re-examine these specimens for me and to confirm (*in litt.,* 3.viii.1978) that they had been correctly identified. The large number of individuals taken in the Nicobars makes it evident that it will be only a matter of time before this migrant is also recorded from the Andamans.

It is relevant to mention that *A. soloensis* is known from the island of Nias, to the west of Sumatra, the history of the record being as follows. Büttikofer (1896) listed a sparrowhawk from Nias under the name *Astur poliopsis* (Hume). Chasen (1935: 71 footnote 2) commented: "Büttikofer's '*poliopsis*' from Nias is stated to have the cere yellow and is therefore probably *A. soloënsis*". On this basis he included Nias in the winter range of *A. soloensis*. Ripley (1944: 323) did not agree: "Chasen lists this species from Nias on the basis of Büttikofer's record of *Accipiter poliopsis*. From the description of the specimen, however, it is impossible to be sure that he did not have a specimen of *poliopsis*". Therefore Ripley restored *A. badius poliopsis* to the Nias list and removed *A. soloensis* from it. Examination of the specimen in our collection revealed that actually Chasen's guess was right: the specimen is undoubtedly referable to *A. soloensis* (♀ ad., 20.xi.1895, Hili Madjeio, Nias, RMNH cat. no. 50). It is perhaps well to add here that the specimen recorded by Büttikofer (l. c.) as *Accipiter virgatus,* is *A. gularis.*

Wattel (1973: 30) states of this species that it is: "Particularly numerous in northern Celebes and not uncommon in eastern Java". This more or less suggests that in western

Java it is uncommon. Our collection contains 129 specimens of *A. soloensis* from Java, of which six in the old collection have no exact locality and eleven are from East Java, so that there are 112 specimens from West Java. This should be compared with the numbers of *A. gularis* and *A. virgatus* given on a preceding page.

The available material is large enough to give some insight in the duration of the stay in the winter quarters. Divided over the different months we get the following numbers:

Month	VIII	IX	X	XI	XII	I	II	III	IV	V
RMNH	1	1	18	36	25	23	27	8	1	—
MV							1			

The earliest dates are 1.viii.1861 (Morotai, leg. Bernstein, RMNH cat. no. 58) and 22.ix.1863 (Negri-Lama, Celebes, leg. Rosenberg, RMNH cat. no. 18), whereas the last date in spring is 15.iv.1925 (Koeningan near Cheribon, Java, leg. F.C. van Heurn, RMNH cat. 51). The August date is so remarkably early that Hartert (1914: 1163) expressed doubt about it: "Ein Stück im Leidener Museum soll am 1. August auf Morty erbeutet sein". Although the specimen is mounted and lacks a collector's label, there seems to be nothing wrong with it. Schlegel (1873: 98) already listed it with this date. Compare the above table with that given on a preceding page for *A. gularis*: whereas the dates of arrival in autumn are not very different, *A. gularis* stays longer in spring. Presumably this is connected with its more northerly breeding quarters.

Brown & Amadon (1968: 514) state that in this species females are larger than males. Although this is correct, the difference is slight and unlike most other species of the genus, it is quite impossible to distingiush the sexes by size alone. The wing-lengths provided by Brown & Amadon are ♂ 185-201, ♀ 200-209 (number of specimens not given) and suggest almost complete segregation, with an overlapping of only 1 mm. The averages found by me in 10 ♂ ad. and 11 ♀ ad. (see table) are 189.0 and 194.1 mm respectively. The averages recorded by Wattel (1973: 31) are 13 ♂ 186.8 and 11 ♀ 195.5 mm, not very different from mine. Note that the size-ranges found by Wattel and by me correspond closely, but that the measurements provided by Brown & Amadon are decidedly larger, especially for the females; their figures were probably copied from La Touche (1932: 189-190) and consultation of that author's work revealed that his figures were based on very few specimens. The number of males is not given, but the female variation was based on three specimens with wings of 200, 200 and 209 mm. Assuming that all La Touche's specimens were correctly identified, and his descriptions look convincing, it seems that he happened to have one exceptionally large individual, or perhaps it is just a difference in method of measuring that is responsible for the large wing-size of his specimens, compared with the larger number measured by me. In order to obtain a better insight in the range of variation possible, I measured the wings of all the females, adults as well as juveniles, in our collection, 53 specimens altogether, and found as maxima for the wing length 202, 203 and 204 mm. All other specimens had a wing length of less than 200 mm.

The identity of *Accipiter nisoides* Blyth

The name *nisoides*, in a subspecific sense, has been used for the Andaman breeding birds by such influential authors as Baker, Peters and, albeit with some doubt, by Wattel (1973). Therefore the name *Accipiter nisoides* deserves a close scrutiny to decide whether it is applicable to the Andaman breeding population, and more generally, what its identity is.

The type specimen was collected in the vicinity of Malacca by R. W. G. Frith, and presented to the museum of the Asiatic Society. It was described as follows (Blyth 1847): "*Acc. nisoides.* Presumed female in mature plumage differing only from that of *Acc. nisus* (common to Europe and India), in its much inferior size, being smaller than the male of *Acc. nisus;* and in having the throat streakless white, excepting a narrow median dark line; the usual lateral lines occur, but not conspicuously, bordering the ear-coverts beneath, which are observable in various other species of Hawks, Eagle-Hawks, & c. Length of wing 7¼ inches, of tail 5½; tarse 1¾ inch; middle toe and claw 1½ in.".

Blyth (1866: 240) himself withdrew the name: "When writing the foregoing remarks I had not the 'Fauna Japonica' at hand. Now that it is before me, I recognize in the figure of the female *A. gularis* an exact representation of my *A. nisoides*". A few years later Blyth (1870: 158) unexpectedly retained *A. nisoides,* placing *A. gularis* in its synonymy. *A. gularis* Temminck & Schlegel (1844) has, obviously, clear priority over *A. nisoides* Blyth (1847). In those years, however, British ornithologists appear to have laboured under the misconception that *A. gularis* was published in 1850 (see for example Sharpe 1874: 151). Therefore this change did not mean a change in Blyth's conclusion that both names referred to the same species.

The synonymy given by Sharpe (1874: 150-151) shows that much confusion existed in those days. Sharpe placed the names *manilensis, besra, gularis, affinis* and *stevensoni* all in the synonymy of *A. virgatus.* These names are now known to be applicable to three different species.

Quite apart from this confusion, one would think that Blyth's own identification of *A. nisoides* with *A. gularis* was positive enough, and it has been accepted by many later authors (Hartert 1914: 1161; Vaurie 1965: 165), but others have applied it to a somewhat hypothetical form supposed to be a resident in south-eastern Asia. As far as I have been able to ascertain, the first to advance the last-mentioned point of view was Baker (1928: 164 and 1935: 115), who recognized it as a valid subspecies of *A. gularis* under the name *A. g. nisoides.* As the characters ascribed to this subspecies were apparent only in the male sex (according to Baker), it is not clear how he could be sure that the female holotype of *nisoides* belonged to it and was not a migrant of the nominate race. Only a few months later Robinson (1928: 27-28) expressed similar ideas. It has now become clear that *A. gularis* occurs in south-eastern Asia as a winter visitor only and that the differential characters listed by Baker and Robinson are within the range of individual variation.

Baker treated *A. virgatus* and *A. gularis* as different species, and definitely associated *A. nisoides* with *A. gularis.* The next step was taken by Peters (1931: 223), who united *A. virgatus* and *A. gularis* to one species, which led automatically to the combination *A. virgatus nisoides.* The distribution he gave to this subspecies was much the same as that given by Baker: "Southern China from Fohkien to Burma, the Andamans and the Malay States". In part of this range *A. v. affinis* was also known to occur, but by ascribing to that subspecies a more westerly distribution, and by assuming migration, he managed to provide *affinis* and *nisoides* with separate breeding ranges. The distribution he recorded for *A. v. affinis* was: "Breeds from the western Himalayas to western China, Yunnan and south to Assam and hills of northern Burma. Winters over the greater part of northern India, southern China (including Hainan and Formosa) and Indo-China". The matter of migration will be discussed in the next section.

Authors dealing specifically with birds of the Malay Peninsula continued to be in doubt about the identity of *A. nisoides*. It is true that Chasen (1935: 72 footnote 2) considered the name more likely to apply to a migratory form than to a resident race. Gibson-Hill (1949: 38) also regarded it as a winter visitor, but as far as I can judge he did not question its validity. Even Medway & Wells (1976: 401-402) felt compelled to discuss the name: "We have not had access to the type of *A. v. nisoides* [*sic*], but Chasen, Gibson-Hill and others have suggested that it was probably a migrant and possibly identical with *A. gularis*. The accuracy of a 19th century localization 'Malacca' is in any case suspect". Note that these authors introduced a new element of doubt: that the localization 'Malacca' is suspect. In general this would be perfectly true, but in this particular case attention should be paid to Blyth's words that the collection to which the type of *A. nisoides* belonged was: "chiefly procured in the vicinity of Malacca", and from the further text it is evident that Blyth at least believed the specimen to have come from near the town of Malacca, an acceptable locality for a migrant *A. gularis*. Whether or not a resident population of *A. virgatus* occurs in the mountains of Malaya, where one would almost expect it on geographical grounds, is a question that can only be solved in the field. It should by now be evident that the name *nisoides* can never be used for such a population, being clearly a synonym of *A. gularis*. For reasons which will be obvious to the informed, I have ignored Cairns's (1963) breeding record from Selama, Perak.

Even though I was and am perfectly satisfied about the identity of *A. nisoides*, I have nevertheless tried to trace the type specimen, but have been unsuccessful. According to Dr. Mukherjee (*in litt.*, 19.ix.1977) it cannot now be found in the Indian Museum, and as it is not listed by Sclater (1892), the specimen has probably disappeared long ago.

Is *Accipiter virgatus affinis* MIGRATORY?

Apparently Hartert (1910: 211) was the first to definitely mention migration in connection with *A. v. affinis*, in the following words: "*Accipiter affinis* appears to inhabit the Himalayas. It is found also in Formosa and Hainan, but it appears to be a winter visitor on these islands, and probably migrates down from the Himalayas in the cold season". This is the somewhat casual way in which the notion that *A. v. affinis* is migratory entered the literature. Hartert's authority ensured this casual opinion being copied uncritically. It was echoed by Baker (1928: 161): "In winter...is found over the greater part of Northern India", further gained in respectability through Peters (1931: 223), was repeated by Ripley (1961: 47): "wintering to the south of its breeding range" and is still found in a slightly modified version in Ali & Ripley (1968: 248). Vaurie (1965: 165) also claimed *A. v. affinis* to be: "Partly migratory, moving down to the plains of northern India in the winter, and to the Indo-Chinese countries, Hainan, and southern China; resident in Formosa where it moves down to the plains during the winter". The latest reviser, Wattel (1973: 36) stated: "*A. v. affinis* shifts to lower levels and to the plains of India, Indochina, and southern China in winter. It appears in fair numbers on Hainan (Hartert 1910). The population on Taiwan also descends from the mountains in the winter".

Thus it may be said that the opinion that *A. v. affinis* is migratory is well-established and time-honoured. Nevertheless it is necessary to state that I have been unable to find much evidence to support it.

Even fifty years ago, Swann (1926: 324) noted that birds from Formosa (Taiwan) are larger than birds from the Himalayas and the former have since been recognized as representing a separate subspecies, *A. v. fuscipectus* Mees, 1970. There is no evidence that *A. v. affinis* ever visits the island. Why in Hainan *A. v. affinis* should have been regarded as a winter visitor only is also unclear. The first to record the species from Hainan was J. Whitehead in 1899 (cf. Ogilvie-Grant 1900: 490); his two specimens were both obtained in the second half of May (cf. Mees 1970: 289). Hartert's (1910: 209) specimens were collected in January, March, April and November. Shaw & Hsu (1966: 97) listed specimens taken in May, June and September. Clearly, *A. v. affinis* is a resident in Hainan.

Hartert's ideas are supported to a certain extent by early records from the Indian Plain, although authors who accepted these records considered them proof of occasional wandering, not of migration. Just the same, they merit a full discussion which will be given below.

The specimens I have examined from the western part of the range come from Kashmir, northern India, Nepal, the extreme north of Bengal (Duars, Jalpaiguri, Darjeeling), the hills of Assam, etc., see specimens listed here and the list of material with dates and localities provided in a previous publication (Mees 1970: table II). There was not a single specimen from the Indian Plain, where according to the authors just quoted *A. v. affinis* would range widely in winter.

The literature consulted provides also little evidence for the occurrence of *A. v. affinis* south of its breeding range. In the light of the confusion between several species that was prevalent in those years, old records from Kutch (Stoliczka 1872: 230), Sambhar Lake (Adam 1873: 368) and Aboo (Hume in Butler 1875: 445) appear questionable. These records were accepted by Blanford (1895: 404-405) and through him have become entrenched in the world literature. Stoliczka's Kutch collection is in the Vienna Museum. At my request Dr. Schifter made a search for *Accipiter* specimens contained in this collection and informed me as follows: "Wir haben zwar Stoliczkas Sammelausbeute aus Kachh erhalten, aber es hat sich darunter kein Exemplar von *Accipiter virgatus* befunden. Ich habe auch in den Eingangsbüchern mit der Originalliste der Sendung nachgesehen und dort sind aus Kachh nur 2 (♂ und ♀) der in Stoliczkas Artikel erwähnten '*Micronisus badius*' verzeichnet, die sich auch in unserer Sammlung befinden (Inv. Nr. 71.213, 71.214)...In seiner Veröffentlichung schreibt Stoliczka bei *A. nisus* and *A. virgatus* allerdings auch nur 'not common'. Offenbar haben daher auch ihm in seiner Sammlung keine Exemplare vorgelegen" (Schifter, *in litt.*, 9.v.1979). In the absence of material to support it, Stoliczka's record should be dismissed. I have not traced the specimens from Sambhar Lake and Aboo. The supposed occurrence near Lucknow in the Ganges Plain is based on Reid (1881: 6): "It is a cold weather visitor, very locally distributed". To this the same pertains as to the older records just listed, especially as in this case there is no reference to a collected specimen. Jesse (1903: 78) was unable to add anything to Reid's observations. Swinhoe & Barnes (1885: 50) wrote under the name *A. virgatus*: "two specimens were obtained **at** Mhow in October 1881" and the measurements provided for the male bird: "Length 11.2 inches, wing 6.75, tail 5.1" do not contradict their identification. In order to verify the identification, I have tried to trace the specimens which I expected to be in the British Museum (cf. Sharpe 1906: 495). However, Mr. Galbraith (*in litt.*, 13.x.1978) informed me as follows: "Unfortunately and oddly, we have not got Swinhoe and Barnes' *Accipiter virgatus* from Mhow. Though the History of the Collections implies that the whole of the Mhow collection came to us in 1884, there are no *A. virgatus* among the 332 birds registered, nor any from Mhow in the collection. Evidently the 332 were not all the birds collected by Swinhoe and Barnes. Since the *A. virgatus* did not come to us later, in one of the accumulative private collections, I suppose that Cambridge and Liverpool are the least unlikely places for the *Accipiters* to have ended up". Following this suggestion I wrote to Cambridge and Liverpool, and in the Merseyside County Museum, Liverpool, one of the two specimens was found. It is not the male of which the measurements were published, but an immature bird sexed as a female. I have examined the specimen and found it to be referable to *A. badius* and obviously a male. As I have failed to trace the other specimen, I cannot prove that that also was misidentified, but it is now very likely that it was, so that the Swinhoe Barnes record of *A. virgatus* from Mhow ca be rejected. It may cause wonder that the mentioned authors misidentified their specimens, as they knew *A. badius*, which they described as a very common bird in Central India. The date and locality of collecting (Mhow, 25.x.1881) and the identification *A. virgatus* appearing on its label provide proof, however, that it actually is one of the birds recorded under that name. Briggs (1931: 399) knew of no other records of *A. virgatus* from Mhow and it is obvious that the species must be removed from the regional list. I have already shown that Baker's (1928: 160) record of *A. virgatus besra* from Mhow is also erroneous.

I am not convinced that the specimens from Lyallpur recorded under the name *A. v. affinis* by Husain & Bhalla (1937: 840) were identified correctly: the habitat, irrigated gardens and fields in an arid country, seems unusual for a forest bird. If the specimens still exist, to which their paper gives no clue, they should be re-examined. It is true that, discussing the habits of *A. v. affinis*, Baker (1928: 162) made the claim that: "In Winter they descend into the plains and at this time keep much less to forest and may be seen in fruit-groves and well-wooded open country", but in this case the alleged shift in habitat in winter only supports my opinion that he confused *A. v. affinis* with *A. badius*.

Swann (1926: 327) quotes Kelham (1881: 365-366) as evidence that *A. v. affinis* is migratory in the Malay Peninsula, but the birds concerned would have been *A. gularis*. Chasen (1935: 72 footnote 2) already observed that some of Swann's remarks given under *affinis* seemed to refer to *gularis*. *A. v. affinis* is unknown from the Malay Peninsula (cf. Medway

& Wells 1976: 406). Medway & Wells did not mention a specimen from Malaya listed as *A. affinis* by Riley: "Dr. W. L. Abbott purchased in Penang an unsexed specimen said to have been shot in the Province of Wellesley". Examination of the specimen (USNM no. 172966) revealed it as an adult female of *A. gularis.*

For Thailand, Hartert's tale of *A. v. affinis* being migratory was eagerly taken up by Robinson (1915: 728). Discussing under the name *A. affinis* two specimens taken on Koh Kut and Koh Rang, islands in the Gulf of Siam, he stated: "There can be little doubt that these two specimens represent the Himalayan *A. affinis* in winter quarters. Specimens precisely agreeing with them except in size have been shot in considerable numbers on small islands in the Straits of Malacca, in company, however, with adult birds with little or no barring on the under surface, that can with difficulty be separated from the true Sundaic *A. virgatus*". The second part of this quotation practically proves that the birds Robinson was discussing were not *A. v. affinis* at all, but immature *A. gularis*. As this record has to my knowledge never been queried in print, I have tried to borrow the specimens. Only one of the two birds could be located in the collections of the former Raffles Museum. It was forwarded for my examination: ♂ im., 21.xii.1914, Koh Rang Island, and as expected proved to be *A. gularis*. Again, Robinson & Kloss (1918: 120-122) claimed *A. v. affinis* to be migratory, but discussing their two specimens of *A. virgatus* from Sumatra (now *A. v. vanbemmeli*), they stated: "both have the 4th and 5th primaries practically equal, whereas the 4th is decidedly the longest in all specimens of *A. v. gularis* and *A. v. affinis* which we have been able to examine". As *A. v. vanbemmeli* and *A. v. affinis* agree in having the 4th and 5th primaries subequal, whereas in *A. gularis* the 4th is a little longer than the 5th (see figures), the birds recorded by Robinson & Kloss under the name *A. v. affinis* could not have been *A. virgatus* but were probably the same immature males of *A. gularis* referred to above. Gyldenstolpe's (1920: 746) record of *A. v. affinis* from Thailand is based on these same two specimens and therefore is equally unacceptable.

More recently the status of *A. v. affinis* in Thailand was summarized by Deignan (1963: 17) in the following words: "A permanent resident on the eastern plateau, but generally distributed on migration or in winter from Chiang Rai south to Prachuap Khiri Khan". The Prachuap Khiri Khan record is evidently based on a specimen from Hat Sanuk near Koh Lak collected by Robinson & Kloss (1923: 105). The record looks reliable, but as there is proof that in 1915 and 1918 Robinson confused *A. v. affinis* with *A. gularis,* it seemed desirable to verify it. The bird is preserved in the Zoology Department, University of Singapore, where the collections of the former Raffles Museum are now stored, but Mrs. Yang (in litt.) informed me that regulations forbade its being made available on loan. Although I was invited to come and examine the specimen in Singpore, this was not really convenient for me, but in November 1979 Dr. D. R. Wells had an opportunity to examine the Hat Sanuk specimen: ♀ ad., 14.iv.1919 (Sing. no. 5302), and to confirm its identity as *A. v. affinis.* Dr. Wells also examined material in the Thailand Institute of Scientific and Technological Research, Bangkok, where he found a ♀ im., 19.vi.1971, from Ban Phu Toei, Sai Yok on the Kwai River (TISTR no. 53-1710). The dates of collecting of these two specimens point to *A. v. affinis* being a resident in south-western Thailand rather than a winter visitor as has been suggested in literature.

TABLE I

SEXUAL DIMORPHISM IN SIZE

	No. of specimens	Wing length (mm)	♂ : ♀ (%)
A. v. virgatus	10 ♂	146.8	
	10 ♀	174.8	84.0
A. v. abdulalii	2 ♂	146.5	
	4 ♀	183.3	80.0
A. v. besra	8 ♂	153.6	
	7 ♀	185.4	82.8
A. v. affinis	27 ♂	165.1	
	33 ♀	199.8	82.7
A. v. fuscipectus	12 ♂	172.4	
	9 ♀	207.8	83.0
A. g. gularis	10 ♂	165.5	
	10 ♀	188.5	87.8
A. g. iwasakii	♂	157	
	♀	181	86.7
A. b. badius	3 ♂	176.7	
	2 ♀	195.5	90.4
A. b. dussumieri	7 ♂	178.3	
	2 ♀	201.0	88.7
A. b. poliopsis	3 ♂	194.3	
	5 ♀	209.8	92.6
A. soloensis	10 ♂	189.0	
	11 ♀	194.2	97.3

Another record that would be indicative of migration is one from Bangkok (Riley 1938: 47). I have examined this bird (USNM no. 306735) and found it to be a perfectly normal adult female of *A. gularis*. Both this and the Wellesley specimens mentioned above bore already the correct identification pencilled on their labels, probably by Deignan. Perhaps this was done after he published his list, or otherwise he has failed to draw the logical consequences of these re-identifications, which are, of course, that in Thailand, as in India, *A. v. affinis* is sedentary and does rarely occur far outside its breeding range.

The locality Nikhe, Thailand, from where Junge & Kooiman (1951: 7) recorded a sparrow-hawk as *A. v. affinis* ♀ im., is also rather far south for this species. A re-examination of the specimen (RMNH no. 12585) revealed that actually it is an immature *A. badius poliopsis*. On the collector's label the bird had been marked as a male (without query), but as the measurements (wing 201, tail 149, column 14, tarsus 54 mm) were much too large for a male of *A. v. affinis*, Junge changed the sex to female: "♂? [=♀ im.]". It should be noted that in this small collection from the Burma Railway there is nowhere else evidence of mis-sexing by the collectors, who were experienced ornithologists. The identification made by Junge was uncritically accepted by me when I drew up a list of material examined of *A. v. affinis* (cf. Mees 1970: 289), as the measurements fitted a female of that subspecies very well (wing 199, tail 149, tarsus 62½, bill from cere 13½ mm). I have once again measured the bird and I now find: wing 200, tail 150, tarsus 52, culmen from cere 13¾, middle toe without nail 32, wing tip 59 mm, primary 2>6 (against 2<6 or at most 2=6 in *A. v. affinis*). The legs of this specimen have been fixed in a stretched position, making it difficult to find the joint between tibiotarsus and tarsometatarsus, and the great length of the latter (agreeing with *A. v. affinis* but not with *A. b. poliopsis*) measured previously, was caused by my having included the distal end of the tibiotarsus. The measurements are entirely right for a male of *A. b. poliopsis*, as sexed by the collectors.

In Indo-China, Hartert has also had influ-

TABLE II

INDIVIDUAL MEASUREMENTS

Sex	Wing	Tail	Tarsus	Bill from cere	Middle toe	Wing tip	Wing tip %	Tail: Wing %	Museum and reg. no.
A. v. virgatus									
10 ♂ ad.	141-152	104-112	45 -49	10¾-12	27-30	32-36	23.4	73.9	RMNH
10 ♀ ad.	170-179	120-134	50½-56	12¾-14¾	31-36	37-44	23.5	73.3	RMNH
A. virgatus abdulalii									
♂	148	103	48	—	28	39	26.3	70.0	BNHS 21897
♂ juv.	145	103	46	12¾	29	40	27.6	71.0	BM 85.8.19.687
♀	185	138	55	15¼	35½	52	28.1	74.6	BNHS 21896
♀	181	129	54½	15¼	35	51½	28.5	71.3	BNHS 23111
♀	183	137	54	15	34½	50	27.3	74.9	BM 85.8.19.690
♀ juv.	184	138	56	15	37	51	27.2	75.0	BM 85.8.19.689
A. v. besra									
♂	152	110	49	11	28½	35	23.0	72.4	BM 1956.44.8
♂	150	107	46	11¼	—	38	25.3	71.3	BM 1959.19.1
♂	158	120	47½	10½	27	39	24.7	75.9	BM 1956.44.7
♂	158	120	47½	10¼	28	38½	24.4	75.9	BM 1955.6.N.20.2803
♂	155	119	50	10¾	29	39	25.2	76.8	BM 77.5.24.17
♂	154	115	48	11	27	39	25.3	74.7	BM 1916.9.20.524
♂	152	115	52	10	27	37½	24.7	75.7	BM 1955.6.N.20.2802
♂	150	112	48½	10½	27	36	24.0	74.7	BM 85.4.10.1
♀	181	141	57	13	35	41	22.6	77.9	BM Gurney 2795
♀	180	140	55	13½	34½	43	23.3	77.8	BM 1949 Whl. 1-169
♀ im.	189	144	56	14	35	45	23.8	76.2	BM 87.11.1.242
♀ im.	181	137	54	13	35	44	24.3	75.7	BM 1949 Whl. 1-168
♀ im.	184	143	55½	13½	34½	49	26.6	77.7	BNHS 20773
♀	190	143	55	—	35	44	23.2	75.3	BNHS 20734
♀	193	145	56	12¾	35½	50	25.9	75.0	BNHS 23911
A. virgatus affinis									
♂	171	126	54	11¼	30½	42	24.6	73.7	BM 77.2.20.6
♂	168	131	52	10¼	31	42	25.0	78.0	BM 1937.1.17.85
♂ im.	160	125	49	11	28	43	26.9	78.1	BM 76.10.20.29
♂ juv.	164	118	52½	11	28	41	25.0	—	BM 1938.7.15.121
♂	164	123	54	11	30	42	25.6	75.0	RMNH cat. 1
♀	204	155	61	14	39	50½	24.8	76.0	BM 1948.80.3652
♀	199	154	61	13¼	38	48	24.1	77.4	BM 1949 Whl. 1-161
♀	197	151	59	13¾	38½	46	23.4	76.6	BM 1921.7.12.31
♀	205	158	64	13	35½	50½	24.6	77.1	BM 85.8.19.684
♀	200	162	63	14¼	37½	49	24.5	81.0	BM 85.8.19.681
♀ im.	197	156	58½	13	35½	52	26.4	79.2	BM 1938.12.13.99
♀ im.	198	149	59	14	36	50	25.3	75.3	BM 97.12.10.1749
♀ im.	194	147	57	13	35	50	25.8	75.8	BM 1949 Whl. 1-170

A. g. gularis

10 ♂	160-169	111-117	46½-51	10-11¼	26-29	49-56	30.9	68.2	RMNH
10 ♀	183-197	120-134	49-54½	12-13½	29½-35	55-66	31.8	68.2	RMNH
♂	170	118	46½	11	27	53	31.2	69.4	BNHS 23926
♂ im.	158+	115	46	10	27½	—	—	—	BNHS 21895
♀ im.	190	134	49	12½	31	57	30.0	70.5	BM 75.6.24.15
♀	192	132	52	12¾	32	58	30.2	68.8	BNHS 22581
♀ im.	184	128	50	12½	31	60	32.6	69.6	BNHS 23700
♀	187	124	49	11½	30	58½	31.3	66.3	USNM 172966
♀	191	129	52	12½	31½	59	30.9	67.5	USNM 306735

A. g. iwasakii

♂	157	112½	50	11¾	27	41	26.1	71.7	AMNH 533881
♀	181	132	53	—	31½	46½	25.7	72.9	AMNH 533880

A. badius badius

♂	175	128	48	11	27	57	32.6	73.1	RMNH 5037
♂	175	126	46½	12½	27½	55	31.4	72.0	RMNH 5088
♂	180	131	44	12¾	28½	58	32.2	72.8	RMNH 5155
♀	197	143	51	14¼	31	58	29.4	72.6	RMNH 4938
♀	194	144	51	14½	32½	61	31.4	74.2	RMNH 4953

A. badius dussumieri

♂ im.	184	139	50½	13	28	57	31.0	75.5	MCM
♂ im.	184	143	48	12¾	25	63	34.2	77.7	RMNH cat. 4
♂ im.	172	129	45	12¾	26	53	31.0	75.0	RMNH 80201
♂	175	127	45	12	26	50	28.6	72.6	RMNH cat. 6
♂	174	125	50	11½	26	53	30.5	71.8	RMNH cat. 5
♂	184	130	47½	12½	28	53½	29.1	70.7	RMNH cat. 1
♂ im.	175	136	47	12	27	51½	29.4	77.7	BM 1938 7.15.112
♀	198	148	54	14	29	62½	31.6	74.7	RMNH cat. 2
♀ im.	204	160	56	16	30	60	29.4	78.4	RMNH cat. 3

A. badius poliopsis

♂	189	141	51	13	28	54	28.5	74.6	RMNH 12584
♂ im.	200	150	52	13¾	32	59	29.5	75.0	RMNH 12585
♂	194	139	51	14	26	58½	30.2	71.6	RMNH cat. 1*
♀	205	154	56	15	31	58	28.3	75.1	RMNH 12583
♀	211	160	56	15	30	59	28.0	75.8	RMNH cat. 2*
♀	214	168	56	15½	32½	59	27.6	78.5	RMNH cat. 1
♀	209	158	54	14	31	65	31.6	75.2	RMNH cat. 2
♀ im.	210	154	57	14¾	30½	63	30.0	73.3	RMNH cat. 3

A. soloensis

10 ♂	183-194	119-128	41½-44	11½-13½	23-26	68-72	37.2	65.6	RMNH
11 ♀	188-197	121-137	42 -49	11¼-14	23-26¼	68-75	36.7	65.6	RMNH

ence as will be clear from this quotation on the distribution of *A. v. affinis*: "Niche dans l'Himalaya jusqu'au Yunnan. En hiver, descend dans l'Inde et l'Indochine. Il est possible qu'il soit sédentaire sur les montagnes du nord du Tonkin et du Laos" (Delacour & Jabouille 1931: 111). Specimens I have examined from Djiring, 18.iii.1927; Blao, 17.ii. 1930; Langbian Peaks, vi.1939; Dalat, 20.vi 1961, and Fyan, 1.viii.1961 (cf. Mees 1970: table II), localities in southern Viet Nam between 11°30′ and 12°N, provide proof that even in the most southerly mountain regions of Viet Nam the species is a permanent resident. In addition there are records from Pleiku in May (David-Beaulieu 1939: 29), Thateng, southern Laos, in December (Engelbach 1932: 458), Tranninh, Laos, in July and August (David-Beaulieu 1944: 75), etc. Clearly *A. v. affinis* ranges throughout the interior of Indo-China, and is sedentary.

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REFERENCES

ABDULALI, H. (1965): The birds of the Andaman and Nicobar Islands. *J. Bombay nat. Hist. Soc. 61*: (1964): 483-571.

———— (1967): The birds of the Nicobar Islands, with notes on some Andaman birds. *J. Bombay nat. Hist. Soc. 64*: 139-190.

———— (1969): A catalogue of the birds in the collection of the Bombay Natural History Society.—3. *J. Bombay nat. Hist. Soc. 65* (1968): 696-723.

ADAM, R. M. (1873): Notes on the birds of the Sambhur Lake and its vicinity. *Stray Feathers 1*: 361-404.

ALI, S. (1969): Birds of Kerala. Oxford University Press, Madras.

ALI, S. & RIPLEY, S. D. (1968): Handbook of the birds of India and Pakistan 1. Oxford University Press, Bombay, London, New York.

AMADON, D. (1975): Why are female birds of prey larger than males? *Raptor Res. 9*: 1-11.

AUSTIN, O. L. & KURODA, N. (1953): The birds of Japan, their status and distribution. *Bull. Mus. Comp. Zool. 109*: 277-637.

BAKER, E. C. STUART (1928): The fauna of British India. Birds 5 (2nd ed.). Taylor and Francis, London.

———— (1935): The nidification of birds of the Indian Empire 4. Taylor and Francis, London.

BANGS, O. (1901): On a collection of birds from the Liu Kiu Islands. *Bull. Mus. Comp. Zoöl. 36*: 253-269.

BLANFORD, W. T. (1895): The fauna of British India. Birds 3. Taylor & Francis, London.

Blyth, E. (1847): Proceedings of the Asiatic Society of Bengal, June, 1847. Zoological department.—Mr. Blyth's report. *J. Asiat. Soc. Bengal 16*: 725-727.

——— (1866): The ornithology of India.—A commentary on Dr. Jerdon's 'Birds of India' (first part). *Ibis* (n.s.) *2*: 225-258.

——— (1870): Notes relating chiefly to the birds of India. *Ibis* (n.s.) *6*: 157-176.

Briggs, F. S. (1931): A note on the birds in the neighbourhood of Mhow. *J. Bombay nat. Hist. Soc. 35*: 382-404.

Brown, L. & Amadon, D. (1968): Eagles, hawks and falcons of the world. Country Life Books, Hamlyn, Feltham, Middlesex.

Butler, E. A. (1875): Notes on the avifauna of Mount Aboo and northern Guzerat. *Stray Feathers 3*: 437-500, *4*: 1-41.

Buttikofer, J. (1896): On a collection of birds from Nias. *Notes Leyden Mus. 18*: 161-198.

Cairns, J. (1963): New breeding records of Malayan birds. *J. Bombay Nat. Hist. Soc. 60*: 140-159.

Chasen, F. N. (1935): A handlist of Malayasian birds. *Bull. Raffles Mus. 11*: i-xx, 1-389.

Cheng, T. H. (1973): [Birds of the Tsinling Mountains]. Academia Sinica, Peking, (Chinese).

——— (1976): [Distributional lists of Chinese birds], rev. ed. Academia Sinica, Peking. (Chinese).

Coomans de Ruiter, L. (1936): Oölogische en biologische aanteekeningen van eenige roofvogels in de westerafdeeling van Borneo. *Org. Cl. Ned. Vogelk. 9*: 34-52.

David-Beaulieu, A. (1939): Les oiseaux de la région de Pleiku (Hauts Plateaux du Sud-Annam). *Ois. Rev. Fr. d'Orn.* (n. s.) *9*: 13-32, 163-182.

——— (1944): Les oiseaux du Tranninh. Ecole Supérieure des Sciences, Hanoi.

Deignan, H. G. (1945): The birds of northern Thailand. *U.S. Nat. Mus. Bull. 186*: v+616 p.

——— (1963): Checklist of the birds of Thailand. *U.S. Nat. Mus. Bull. 226*: x+263 p.

Delacour, J. & Jabouille, P. (1931): Les oiseaux de l'Indochine Francaise II. Exposition Coloniale Internationale, Paris.

Dharmakumarsinhji, R. S. (1956): Besra Sparrow-Hawk (*Accipiter virgatus*) in Saurashtra. *J. Bombay nat. Hist. Soc. 53*: 699-701.

Engelbach, P. (1932): Les oiseaux de Laos meridional. *Ois. Rev. Fr. d'Orn.* (n. s.) *2*: 439-498.

Etchecopar, R. D. & Hue, F. (1978): Les oiseaux de Chine. Editions du Pacifique, Papeete, Tahiti.

Flint, V. E., Bohme, R. L., Kostin, Yu, V. & Kuznetsov, A. A. (1968): [Birds of the USSR]. Mysl, Moscow. (Russian).

Fu, T. S. (1937): L'Etude des oiseaux du Ho-Nan. These presentée a la Faculté des Sciences de Dijon. Imprimerie Moderne, Langres.

Gibson-Hill, C. A. (1949): An annotated checklist of the birds of Malaya. *Bull. Raffles Mus. 20*: 1-299.

Gore, M. E. J. & Won Pyong-Oh (1971): The birds of Korea. Seoul.

Grossman, M. L. & Hamlet, J. (1965): Birds of prey of the world. Cassell, London.

Gurney, J. H. (1863): On *Accipiter stevensoni*, a new species of hawk from China. *Ibis 5*: 447-450.

Gyldenstolpe, N. (1920): A nominal list of the birds at present known to inhabit Siam. *Ibis* (11) *2*: 446-496, 569-607, 735-780.

Hachisuka M. & Udagawa, T. (1951): Contribution to the ornithology of Formosa. Part II *Quart. J. Taiwan Mus. 4*: 1-180.

——— ——— (1953): Contribution to the ornithology of the Ryukyu Islands. *Quart. J. Taiwan Mus. 6*: 141-279.

Hartert, E. (1910): The birds of Hainan. *Novit. Zool.* 17: 189-254.

——— (1914): Die Vögel der paläarktischen Fauna II (Heft 3). R. Friedländer & Sohn, Berlin.

Hoogerwerf, A. (1948): Contribution to the knowledge of the distribution of birds on the island of Java. *Treubia 19*: 83-137.

——— (1970): On the ornithology of the rhino sanctuary Udjung Kulon in West Java (continued). *Nat. Hist. Bull. Siam Soc. 23*: 447-500.

Hume, A. O. (1874): Contributions to the ornithology of India. The islands of the Bay of Bengal. *Stray Feathers 2*: 29-324.

——— (1876): Additional notes on the avifauna of the Andaman Islands. ibid. 4: 279-294.

Husain, M. A. & Bhalla, H. R. (1937): Some birds of Lyallpur and their food. *J. Bombay nat. Hist. Soc. 39*: 831-842.

Jesse, W. (1903): A list of the birds of Lucknow, Part III. *Ibis* (8) *3*: 49-81.

JUNGE, G. C. A. (1948): Notes on some Sumatran birds. *Zool. Meded. 29*: 311-326.

——— & KOOIMAN, J. G. (1951): On a collection of birds from the Khwae Noi Valley, western Siam. *Zool. Verh. 15*: 1-38.

KELHAM, H. R. (1881): Ornithological notes made in the Straits Settlements and in the western states of the Malay Peninsula (Part I). *Ibis* (4)*5*: 362-395.

KING, B. F. & DICKINSON, E. C. (1975): A field guide to the birds of south-east Asia. Collins, London.

KOLTHOFF, K. (1932): Studies on birds in the Chinese provinces of Kiangsu and Anhwei 1921-1922. *Göteborgs K. Vet. Vitt.-Sam. Handl.* (5) B *3*: 1-190.

KURODA, N. (1936): Birds of the Island of Java. II: Non-passeres. Tokyo.

LADZYUK, V. I., NAZAROV, YU. N. & NECHAEV, V. A. (1971): The birds of the islands in the northwestern part of the Gulf Petra Velikogo. *Inst. Pedol. Biol., Far-Eastern Sci. Cent., Acad. Sci. USSR, Proc.* (n. s.) *6*: 52-78. (Russian with English subtitle).

LA TOUCHE, J. D. D. (1931-1934): A handbook of the birds of eastern China II. Taylor and Francis, London.

LE FEVRE, R. H. (1962): The birds of north Shantung Province, China, York, Pennsylvania.

MAYR, E. (1949): Geographical variation in *Accipiter trivirgatus. Amer. Mus. Novit.* 1415: 1-12.

MEDWAY, LORD & WELLS, D. R. (1976): The birds of the Malay Peninsula 5. H. F. & G. Witherby Ltd., Penerbit Universiti Malaya, London, Kuala Lumpur.

MEES, G. F. (1970): Notes on some birds from the island of Formosa (Taiwan). *Zool. Meded. 44*: 285-304.

MISHIMA, T. (1962): A new race of *Accipiter virgatus* and validity of the race *pullus* of the Common Noddy for Riu Kiu Is. *Tori 17* (79/80): 219-222.

MORIOKA, H. (1974): Avifauna of the Ryukyu Islands and its origin. *Mem. Nat. Sci. Mus. Tokyo 7*: 203-211. (Japanese with English summary).

NAZAROV, YU. N. & LABZYUK, V. I. (1975): On the avifauna of south Primorye. *Inst. Pedol. Biol, Far-Eastern Sci. Cent., Acad. Sci. USSR, Proc.* (n. s.) 29: 268-276. (Russian with English summary).

OGILVIE-GRANT, W. R. (1896): On the birds of the Philippine Islands.—Part VI. The vicinity of Cape Engano, N. E. Luzon, Manila Bay, and Fuga Island, Babuyan Group. *Ibis* (7)*2*: 101-128.

——— (1900): On the birds of Hainan. *Proc. Zool. Soc. Lond.*: 457-504.

ORNITHOLOGICAL SOCIETY OF JAPAN (1975): Check-list of Japanese birds. Fifth and revised edition-1974 (2nd printing). Gakken Co. Ltd., Tokyo.

OSMASTON, B. B. (1906): Notes on Andaman birds. with accounts of the nidification of several species whose nests and eggs have not been hitherto described. Part II. *J. Bombay nat. Hist. Soc. 17*: 486-491.

PARKES, K. C. (1973): Annotated list of the birds of Leyte Island, Philippines. *Nemouria* 11: 1-73.

PELZELN, A. v. (1865): Vogel. Nocara Exp., Zool. *1*: i-iv, 3-176.

PETERS, J. L. (1931): Check-list of birds of the world 1. Harvard University Press, Cambridge. Mass.

REID, G. (1881): The birds of the Lucknow Civil Division. *Stray Feathers* 9: 491-504, *10*: 1-88.

RICHMOND, C. W. (1902): Birds collected by Dr. W. L. Abbott and Mr. C. B. Kloss in the Andaman and Nicobar Islands. *Proc. U. S. Nat. Mus. 25*: 287-314.

RILEY, J. H. (1938): Birds from Siam and the Malay Peninsula in the United States National Museum collected by Drs. Hugh M. Smith and William L. Abbott. *U. S. Nat. Mus. Bull. 172*: iv + 581 p.

RIPLEY, S. D. (1944): The bird fauna of the west Sumatra islands. *Bull. Mus. Comp. Zoöl. 94*: 305-430.

——— (1961): A synopsis of the birds of India and Pakistan. Bombay Natural History Society, Bombay.

ROBINSON, H. C. (1915): On birds collected by Mr. C. Boden Kloss, F. R. G. S., M. B. O. U., on the coast and islands of south-eastern Siam. *Ibis* (10) *3*: 718-761.

——— (1928): The birds of the Malay Peninsula II. H. F. & G. Witherby, London.

——— & KLOSS, C. B. (1918): Birds of Korinchi. *J. Fed. Malay St. Mus. 8*: 81-284.

——— (1923): The birds of south-west

and peninsular Siam (continued). *J. Nat. Hist. Soc. Siam 5*: 89-218.

Salomonson, F. (1953): Fra Zoologisk Museum XVII. 4. Traekfugle iagttaget og indsamlet i den Bengalske Havbugt, Rodehavet og Middelhavet. *Dansk Orn. For. Tidsskr. 47*: 134-138.

Schlegel, H. (1862): Astures. *Mus. Hist. Nat. Pays-Bas* 2 (mon. 5): 1-57.

—————— (1873): Revue de la collection des oiseaux de proie faisant partie du Musée des Pays-Bas. *Mus. Hist. Nat. Pays-Bas* 2 (mon. 36): 1-156.

Sclater, W. L. (1892): On the Indian Museum and its collection of birds. *Ibis* (6) *4*: 65-87.

Sharpe, R. B. (1874): Catalogue of the birds in the British Museum 1. British Museum, London.

—————— (1906): Birds. The history of the collections contained in the natural history departments of the British Museum 2: 79-515.

Shaw, T. H. (1936): The birds of Hopei Province. *Zool. Sin.* (B) *15* (1): i-xxxiv, 1-974.

—————— (1938): The avifauna of Tsingtao and neighbouring districts. *Bull. Fan Mem. Inst. Biol. Zool. 8*: 133-222.

Shaw, T. H. & Hsu, W. S. (1966): On the birds of Hainan. I. Non-Passeriformes. *Acta Zool. Sin. 18*: 94-112. (Chinese with a summary in English).

Smythies, B. E. (1957): An annotated checklist of the birds of Borneo. *Sarawak Mus. J. 7*: iii-xv, 523-818.

—————— (1960): The birds of Borneo. Oliver & Boyd, Edinburgh, London.

—————— (1968): The birds of Borneo, 2nd ed. Oliver & Boyd, Edinburgh and London.

Sody, H. J. V. (1953): Vogels van het Javaanse djatibos. *Madj. Ilmu Alam Ind.* (*Nat. Tijdschr. Ned. Ind.*) *109*: 125-172.

Stepanyan, L. S. (1959): Notes on systematics of some birds. *Ornithologia 2*: 77-80. (Russian).

Stoliczka, F. (1872): Notice on the mammals and birds inhabiting Kachh. *J. Asiat. Soc. Bengal 41*: 211-258.

Stresemann, E. (1923): Ueber einige *Accipiter*-Arten. *J. f. Orn. 71*: 517-525.

—————— (1941): Die Vögel von Celebes. Teil III. Systematik und Biologie. (Schluss). *J. f. Orn. 89*: 1-102.

Stresemann, E. & Heinrich, G. (1940): Die Vogel des Mount Victoria. *Mitt. Zool. Mus. Berlin 24*: 151-264.

Swann, H. K. (1921-1922): A synopsis of the Accipitres (2nd ed.). Wheldon & Wesley, Ltd., London.

—————— (1926): A monograph of the birds of prey 1 (5). Wheldon & Wesley, Ltd., London.

Swinhoe, C. & Barnes, H. (1885): On the birds of Central India.—Part I. *Ibis* (5) *3*: 52-69.

Swinhoe, R. (1874): Ornithological notes made at Chefoo (Province of Shantung, North China). *Ibis* (3) *4*: 422-447.

Vaurie, C. (1965): The birds of the Palearctic fauna. Non-Passeriformes. H. F. & G. Witherby, London.

Voous, K. H. (1950): Geographical variation in the Lesser Sparrow Hawks from Indonesia (*Accipiter virgatus*). *Amsterdam Nat. 1*: 95-107.

Warren, R. L. M. (1966): Type-specimens of birds in the British Museum (Natural History) 1. Non-passerines. British Museum (Natural History), London.

Wattel, J. (1972): Geografische differentiatie in het genus *Accipiter*. Luxora, Wormerveer.

—————— (1973): Geographical differentiation in the genus *Accipiter*. Publ. Nuttall Orn. Cl. 13.

Whistler, H. (1944): The avifaunal survey of Ceylon conducted jointly by the British and Colombo Museums. *Spolia Zeyl. 23*: 119-321.

Whistler, H. & Kinnear, N. B. (1936): The Vernay scientific survey of the Eastern Ghats (ornithological section). Part XIII. *J. Bombay nat. Hist. Soc. 38*: 418-437.

Wickham, P. F. (1910): Note on the nesting of the Besra Sparrow Hawk (*Accipiter virgatus*) and the Andaman Nightjar (*Caprimulgus andamanicus*) in the Andamans. *J. Bombay nat. Hist. Soc. 19*: 992-993.

STUDIES ON THE CHARACTERISTICS OF HAIR IN SOME INDIAN BATS: (MAMMALIA: CHIROPTERA)[1]

J. H. Sabnis[2]

(With nineteen text-figures)

This paper describes the characteristics of hair of some Indian chiroptera. A series of camera lucida diagrams depicting the hair structure of 19 species of bats is presented. The structural pattern of the hair of bats reveals variations at generic as well as species levels.

INTRODUCTION

The present study was undertaken in order to contribute information on the structure of hair in some Indian chiropteran forms in the light of the new method of description suggested by Adorjan and Kolenosky (1969).

MATERIAL AND METHODS

The hairs used for the study were from the dorsal side of the body. They were carefully washed in hot water and slides were prepared in Canada balsum after they were air dried thoroughly and passed through ether and xylol. The camera lucida drawings were drawn of each hair showing cuticular and medullar pattern. The proximal, medial and distal regions of the hairs were observed. The measurements given are averages. The diagrams on the left side in the plate show the structure of the hair at proximal end, in the middle the medial and the right the distal end.

OBSERVATIONS

The basic parts of a typical mammalian hair are the cuticle, cortex, medulla, pigment and hair cells. In the system of hair identification to be outlined only cuticle and medulla are important. The structure of these patterns which form the basis of hair indentification under study are given according to order and family of the specimens. They are arranged according to order and families of the species as given by Simpson (1945).

Family PTEROPIDAE

Cynopterus sphinx gangeticus (Fig. 1)

Gross appearance:

Length 8 mm. Hair stem soft and slender. Colour greyish, basally white, diameter of proximal region 24 μ.

Microscopic appearance:

Hair nodular with corollar serrate edges in the proximal region and the medial region. Borders appear spiny distally. Medulla continuous in the proximal region but fragmented having a beaded appearance in the medial region.

Rousettus leschenaulti (Fig. 2)

Gross appearance:

Length 4 mm. Hair stem soft. Colour white in the proximal region followed by chocolate grey in the middle region; distal region yellow. Diameter at the proximal region 15 μ.

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Microscopic appearance:

Scales are corollary with spinulate borders in the proximal and medial regions. Distal region borders appear serrate. Hair non-medullated.

Pteropus giganteus giganteus (Fig. 3)

Gross appearance:

Length 1.2 cm. Colour white at the proximal region; brown in the medial region and greyish yellow in the distal region. Some hairs are pure black. Hair stems narrow at proximal becoming a little broader in the medial and tapering in the distal region. Diameter at the proximal region 18 μ.

Microscopic appearance:

Scales imbricate with crenate borders in the proximal and the medial region. In the distal region the border appears serrate. The medulla is not visible in the proximal region and the distal region, but it is fragmented in the middle region.

Family Rhinopomatidae

Rhinopoma hardwickei (Fig. 4)

Gross appearance:

Length 5 mm. Hairs slender and soft. Hairs differ in colour, some being black and some brown. They measure 12 μ in diameter in the proximal region.

Microscopic appearance:

Scales of corollary type with three to four dentate spines on their borders in the proximal and medial regions. Distal region spiny. Medulla fragmented proximally, while it has a beaded appearance in the medial region. Medulla not visible distally.

Family Emballonuridae

Taphozous perforatus (Fig. 5)

Gross appearance:

Length 6 to 7 mm. Hair stems soft and slender. Colour of hair white in the proximal region and black in the medial region. The remaining distal part is grey. Diameter of the hair at the proximal region 21 μ.

Microscopic appearance:

Hairs are nodular with corollary serrate borders in the proximal region, and dentate in the medial region. Distal region spiny. Pigment uniformly distributed along the border of the hair but central area appears lightly coloured. Hairs are of the non-medullated type.

Taphozous melanopogon (Fig. 6)

Gross appearance:

Length 6 mm. They measure 12 μ in diameter at the proximal region. Colour of hair greyish white in the proximal region, brown medially and white tipped.

Microscopic appearance:

Hairs nodular with corollar serrate borders in the proximal and medial region. Borders of the distal region dentate. Pigment of hair localised at the nodular girdle. Hair is of the non-medullated type.

Taphozous longimanus (Fig. 7)

Gross appearance:

Length 6 mm. Hairs slender and soft. Hair distally and proximally black; grey in the medial region. Measure 12 μ in diameter at the proximal region.

Microscopic appearance:

Hair nodular with spinulate borders in the proximal region and dentate in the medial region. Distal region with a serrate border. Pigment uniformly distributed. The hair is of the non-medullated type.

Taphozous theobaldi (Fig. 8)

Gross appearance:

Length 5 to 7 mm. Hair stems soft and slender. Diameter of the proximal region 12 μ. Colour of hair white in the proximal region, and dark chocolate brown in the medial and distal regions.

Microscopic appearance:

Hairs nodular with corollar serrate borders. Pigment distributed in the inter-nodular area; nodular girdle lightly coloured. The hair is of the non-medullated type.

Taphozous kacchensis (Fig. 9)

Gross appearance:

Length 2 to 3 mm. Measure 21 μ in diameter proximally. Proximal one third of the hair white, remaining section black.

Microscopic appearance:

Hairs nodular with corollar serrate scales. Internodular areas pigmented in such a way that the dark rectangular patches are localised on either side of the centrally lighter coloured area. Hair is of the non-medullated type.

Family MEGADERMATIDAE

Megaderma lyra lyra (Fig. 10)

Gross appearance:

Length 8 mm. Measure 9 μ at the proximal region. Colour of hair in the proximal region white, remaining areas greyish black.

Microscopic appearance:

The hairs are nodular, corollar dentate in the proximal region, medially serrate, but in the distal region it appears spiny. The medulla in the proximal region appears continuous but in the medial region it is fragmented beaded type. In the distal region the medulla is not visible.

Family RHINOLOPHIDAE

Rhinolophus lepidus lepidus (Fig. 11)

Gross appearance:

Length 4 mm. Colour of hair white in the proximal region gradually changing to yellowish grey in the medial region, distally light brown. The hair measures 9 μ at the proximal end.

Microscopic appearance:

Hairs nodular with corollar dentate borders. Nodular pattern uniform throughout except in the proximal region which has sympodial nodular arrangement. The hair stems are of the non-medullated type.

Family HIPPOSIDERIDAE

Hipposideros fulvus fulvus (Fig. 12)

Gross appearance:

Length 4 mm. Hair stems soft and slender. Colour of hair, white in the proximal region, medially greyish brown and distally black. Diameter of the proximal region 9 μ.

Microscopic appearance:

Hair appears nodular with corollar pattern with serrate borders in the proximal and medial regions. Nodes reduced in size in the distal region which appears pointed. Hairs stems are non-medullated.

Hipposideros cineraceus (Fig. 13)

Gross appearance:

Length 4 mm. Hair stems slender. Colour of hair half yellow and half chocolate brown. Diameter of proximal region, 12 μ.

Microscopic appearance:

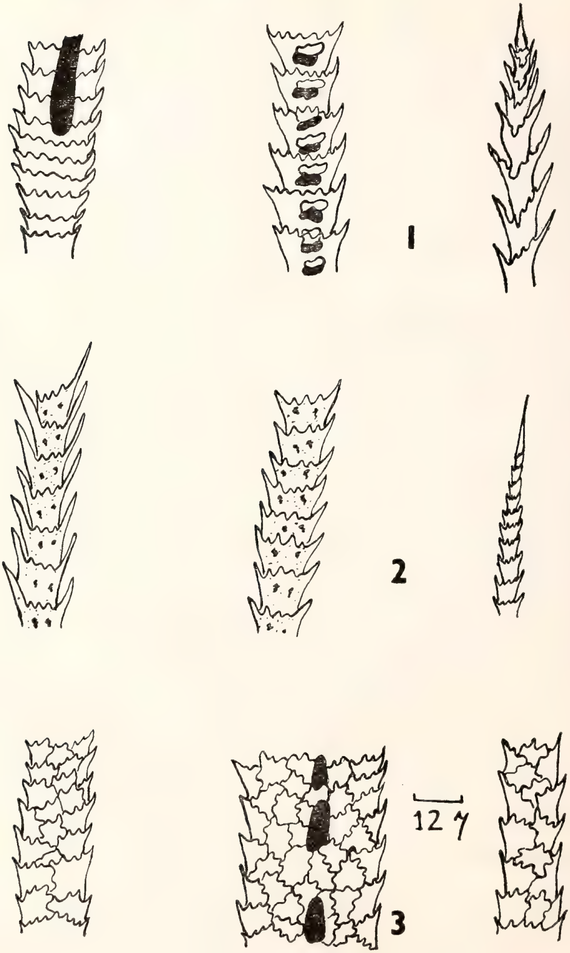
Hairs appear nodular with corollar scale pattern, the borders of which appear plain in the proximal and medial regions. In the distal region the corollar borders are serrate. Hair stems are non-medullated.

Family VESPERTILIONIDAE

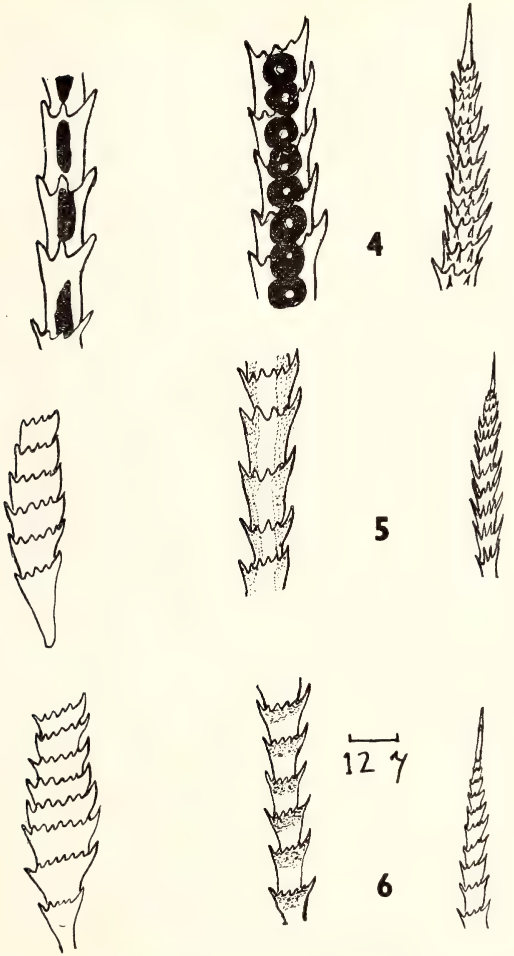
Pipistrellus coromandra (Fig. 14)

Gross appearance:

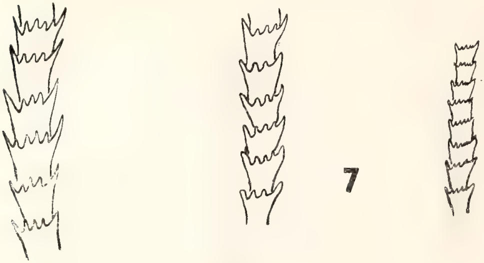
Length 6 mm. Colour of hair yellow proximally, middle two third dark chocolate and remaining portion yellowish brown. Diameter



Diagrammatic representation of hair structure of bats in 1. *Cynopterus sphinx*, 2. *Rousettus leschenaulti*, 3. *Pteropus giganteus giganteus*.



Diagrammatic representation of hair structure of bats in 4. *Rhinopoma hardwickei*, 5. *Taphozous perforatus*, 6. *Taphozous melanopogon*.



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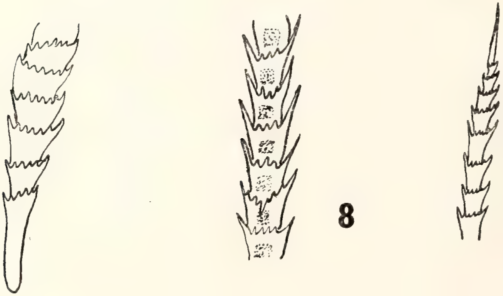

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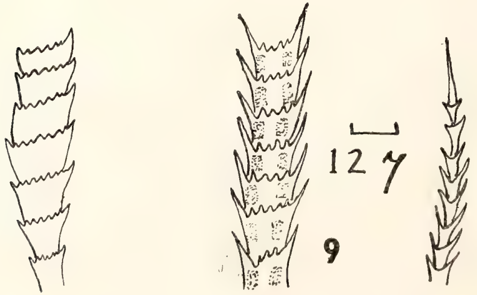

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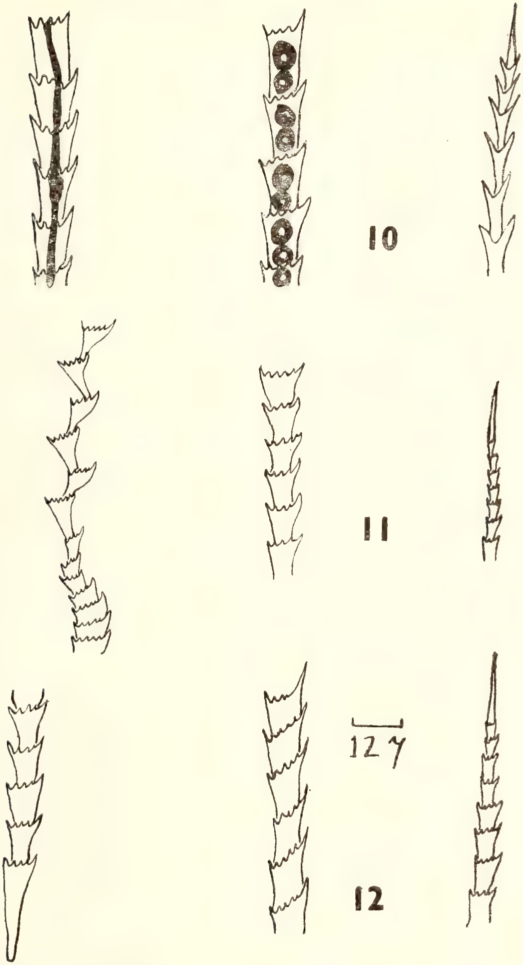
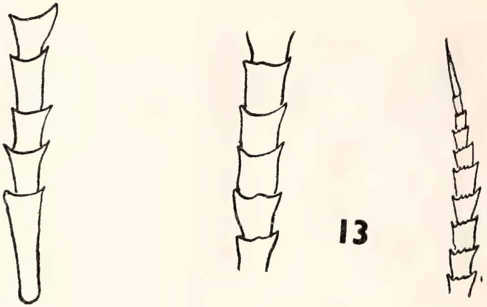
Diagrammatic representation of hair structure of bats in 7. *Taphozous longimanus*, 8. *Taphozous theobaldi*, 9. *Taphozous kacchensis*.



Diagrammatic representation of hair structure of bats in 10. *Megaderma lyra lyra*, 11. *Rhinolophus lepidus lepidus*, 12. *Hipposideros fulvus fulvus*.



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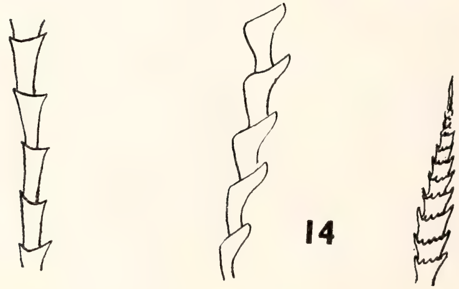

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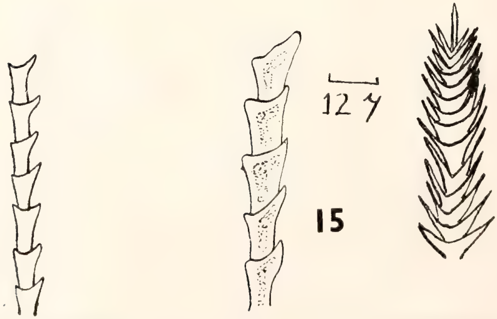

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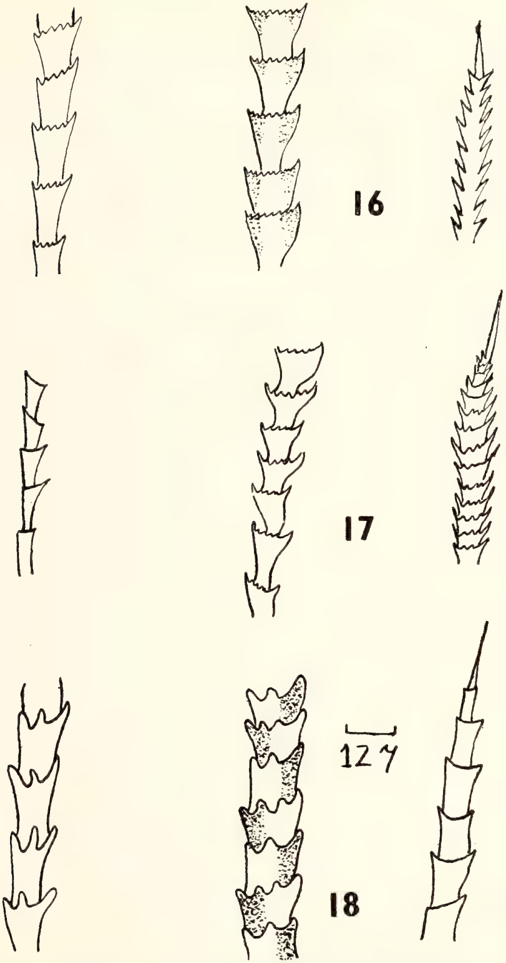
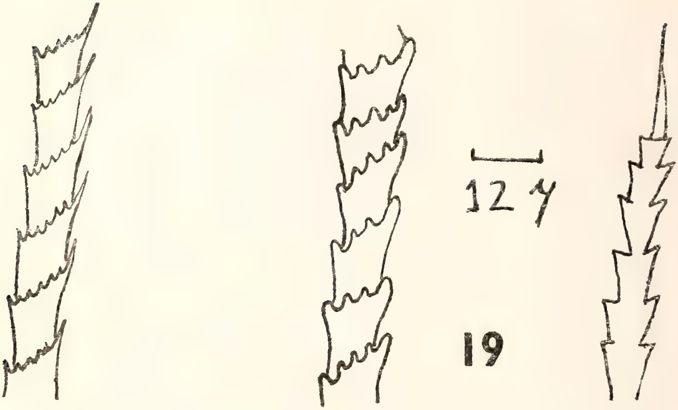
Diagrammatic representation of hair stucture of bats in 13. *Hipposideros cineraceus*, 14. *Pipistrellus coromandra*, 15. *Pipistrellus mimus*.



Diagrammatic representation of hair structure of bats in 16. *Pipistrellus ceylonicus*, 17. *Pipistrellus dormeri*, 18. *Scotophilus temmincki*.



Diagrammatic representation of hair structure of bats in 19. *Scotophilus heathi.*

at proximal region, 9 μ

Microscopic appearance:

Hairs nodular with plain borders in the proximal and medial regions. Distal region spiny. Hair stems non-medullated.

Pipistrellus mimus (Fig. 15)

Gross appearance:

Length 4 to 5 mm. Colour of the first two thirds black; and remaining one third, grey. Diameter at the proximal region 9 μ.

Microscopic appearance:

Hairs nodular with corollar scales having plain borders in the proximal and medial regions. Distal tip has the shape of a wheat grain. Pigment localised in the inter-nodular area.

Pipistrellus ceylonicus (Fig. 16).

Gross appearance:

Length 5 mm. Colour of hair white proximally, gradually changing to chocolate medially. Distal region light brown. Diameter of the hair at the proximal region 9 μ.

Microscopic appearance:

Hairs nodular with corollar serrate scales in the proximal and medial regions. Distal region spiny. Pigment localised in the nodular area. Hairs non-medullated type.

Pipistrellus dormeri (Fig. 17)

Gross appearance:

Length 5 mm. Colour of hair, uniform grey. Diameter at the proximal region 9 μ.

Microscopic appearance:

Hairs nodular with corollar scales having plain borders in the proximal region, gradually changing to serrate scales medially. The borders appear dentate distally. Hair stems non-medullated.

Scotophilus temmincki (Fig. 18)

Gross appearance:

Length 4 mm. Colour of hair white in the proximal region and brown in the distal region. In the medial region the white band is separated by yellow band on either side. Diameter at the proximal region 12 μ.

Microscopic appearance:

Hairs nodular with corollar dentate scales having three to four denticles in the proximal and medial regions. In the distal region corollar surface plain ending in a pointed tip. Pigment distributed at inter-nodular area on either side alternately. Hair stems non-medullated.

Scotophilus heathi (Fig. 19)

Gross appearance:

Length 3 mm. Colour of hair brownish yellow proximally and black distally, but is brown in the medial region. Diameter at the proximal region 12 μ.

Microscopic appearance:

Hairs nodular with corollar serrate scales in the proximal region, gradually changing to dentate in medial region. The distal borders of the hair appear serrate.

CONCLUSION

According to the nature of the structure of the chiropteran hair is of two types. The hairs of *Cynopterus sphinx*, *Pteropus giganteus giganteus*, *Rhinopoma hardwickei* are of the medullated type, while those of *Rousettus*, *Taphozous*, *Pipistrellus* and *Scotophilus* species are of non-medullated type.

From the point of view of the scale patterns the hairs of bats may be roughly divided into two kinds—the nodular corollar type and the imbricate type. The megachiropteran forms *Cynopterus sphinx* and *Rousettus leschenaulti* have corollar type of scales, while *Pteropus giganteus giganteus* showed the presence of imbricate crenate type of scales. All the genera and species which belong to families of Rhinopomatidae, Emballonuridae, Megadermatidae, Rhinolophidae, Hipposideridae, and Vespertilionidae showed corollar type of scales.

The families Pteropidae, Rhinopomatidae and Megadermatidae show common medular corollar hair structure, while non-medullated corollar scales are characteristic feature, for the majority of Microchiropteran forms studied. The structural hair pattern of *Pteropus giganteus giganteus* is entirely different from that of other chiropteran forms investigated. It is medullated with imbricate crenate types of scales.

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REFERENCES

ADORJAN, A. S. AND KOLENOSKEY, G. B. (1969): A manual for the identification of hairs of selected Ontario Mammals. Department of Lands and Forests Research Report 90.

SIMPSON, G. G. (1945): The principles of classification and a classification of Mammals. *Bull. Amer. Mus. Nat. Hist. 85*: 1-350.

SEDGES OF PUNJAB—ECOLOGY, DISTRIBUTION AND ENUMERATION[1]

M. Sharma[2]

The paper gives a comprehensive ecological and distributional survey of the sedges of Punjab. 50 species have been enumerated along with their flowering and fruiting periods and field numbers. Four sedges, namely *Cyperus atkinsonii* Cl., *C. bulbosus* Vahl, *Eleocharis acutangula* Sch. and *Scirpus triqueter* L. are new to the flora of Punjab plain.

INTRODUCTION

The sedges are members of the Cyperaceae, a large family comprising of about 4,000 species distributed among nearly 90 genera (Airy Shaw 1973). They are of cosmopolitan distribution but are particularly abundant in the temperate and subarctic regions of both the hemispheres, mainly as marsh-plants. Studies on the taxonomy and distribution of Cyperaceae have received good amount of attention throughout the world including India (cf. Tiwari & Maheshwari 1964). But the taxonomic treatment of this group in the floras or botanical reports of erstwhile composite Punjab or any of its parts (Edgeworth 1838, 1842; Aitchison 1868, 1869; Stewart 1869; Coventry 1901; Collett 1902; Bamber 1916; Parker 1918; Kashyap & Joshi 1936; Sabnis 1940) has remained neglected so far. It is pertinent to point out here that the family Cyperaceae has not been dealt with by Bamber (1916), Parker (1918) and Kashyap & Joshi (1936). To complete the last work Ahmad (1954) published a supplement that deals with the sedges and grasses of Lahore, no more a part of present Punjab (India). One exception is Collett's FLORA SIMLENSIS which does deal comprehensively with the sedges but from the hilly terrain of Simla. This treatment is virtually of no use to the thrice truncated Punjab (mainly a plain country) since 1947. Whatever little that has been written about the sedges of this region in the above-mentioned works is nomenclaturally anachronistic. The present account is an attempt to fill that gap and is based on the collections made during numerous botanical excursions undertaken by me uninterruptedly for nearly fifteen years, as a part of the survey of the flora of Punjab state. In continuation with my other preliminary floristic observations dealing with Punjab or its parts (Sharma & Sharma 1966; Sharma 1974, 1975, 1977; Sharma & Sharma 1974) this publication is a further step in the compilation of the flora of reorganized Punjab.

SOILS AND CLIMATE

The present state of Punjab is essentially monotonous plain country with arid to semi-arid climate, scanty to moderate (48-110 cm per year) precipitation and very low to very high (—1.7°C to 48.3°C) temperatures. Soils are sandy to sandy-loam. Somewhat moist, rocky Siwaliks rising to 665 m and with an annual rainfall of 85-125 cm delimit Punjab along its north-eastern border.

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ECOLOGY AND DISTRIBUTION OF SEDGES

Edaphic and climatic factors prevailing during the different seasons of the year affect the occurrence and distribution of sedges. Rainy season is the most favourable for their germination, development and survival. With the advent of the drier season the cyperaceous vegetation dries up. Perennials manage to survive through rhizomes and tubers. Only a few sedges flourish in dry soil. Noteworthy among these being *Bulbostylis barbata* Cl., *Cyperus arenarius* Retz., *C. atkinsonii* Cl., *C. bulbosus* Vahl, *C. rotundus* L. and *Fimbristylis falcata* Kunth. In this category also fall the sedges recorded from Siwaliks such as *Cyperus niveus* Retz., *C. paniceus* Boeck. var. *roxburghianus* Kuk. and *Eriophorum comosum* Nees; the last one being the most conspicuous on steep rocks or hanging from vertical cliffs. Besides, *Cyperus compressus* L., *C. michelianus* Link subsp. *pygmaeus* Asch. & Graebn., *C. squarrosus* L., *C. triceps* Endl., *Fimbristylis bisumbellata* Bub., *F. dichotoma* Vahl, *F. ferruginea* Vahl, *F. ovata* Kern, *F. schoenoides* Vahl, *F. tenera* Roem. & Sch. var. *oxylepis* Cl. and *Scirpus tuberosus* Desf. can survive on damp to dry soil. Most of these appear with the onset of monsoon and have been observed to thrive well in dry areas.

The sedges form the most conspicuous communities in or near the banks of rivers, canals irrigation courses, ponds, pools, puddles and ditches. Common ones included here are *Carex fedia* Nees, *Cyperus alopecuroides* Rottb., *C. alulatus* Kern, *C. brevifolius* Hassk., *C. compactus* Retz., *C. difformis* L., *C. digitatus* Roxb., *C. eleusinoides* Kunth, *C. exaltatus* Retz., *C. globosus* All., *C. iria* L., *C. pumilus* L., *C. rotundus* L., *C. sanguinolentus* Vahl, *C. serotinus* Rottb., *Eleocharis dulcis* Hensch., *E. palustris* R. Br., *Fimbristylis bisumbellata* Bub., *F. dichotoma* Vahl, *F. ferruginea* Vahl, *F. quinquangularis* Kunth, *Scirpus litoralis* Schrad., *S. mucronatus* L., *S. roylei* Parker and *S. tuberosus* Desf.

In the rice-fields which provide marshy habitat *Cyperus alulatus* Kern, *C. compressus* L., *C. difformis* L., *C. iria* L., *C. rotundus* L., *C. tenuispica* Steud., *Eleocharis atropurpurea* Presl, *Fimbristylis miliacea* Vahl, *F. quinquangularis* Kunth, *Scirpus roylei* Parker, *S. supinus* L., *S. tuberosus* Desf. grow most luxuriantly. *Cyperus alulatus* Kern, *C. compressus* L., *C. iria* L., *C. rotundus* L., *C. squarrosus* L. and *Fimbristylis tenera* Roem. & Sch. var. *oxylepis* Cl. also grow as weeds in other kharif crops. *Bulbostylis barbata* Cl., *Cyperus bulbosus* Vahl and *C. rotundus* L. inhabit the groundnut fields which offer extremely sandy and xerophytic habitat—an unusual locality for sedges.

While *Cyperus kyllingia* Endl. and *C. triceps* Endl. grow in gardens and fruit orchards as a herbaceous undergrowth on moist, grassy areas; others like *Cyperus alulatus* Kern, *C. bulbosus* Vahl, *C. compressus* L., *C. iria* L., *C. rotundus* L. and *Scirpus tuberosus* Desf. are common in moist, waste lands along roadsides during the monsoon period.

Cyperus flabelliformis Rottb. is the only member of the Cyperaceae which has been observed as an ornamental grown in the gardens of Punjab in green houses or on rockeries.

SYSTEMATIC ENUMERATION

In all 50 species belonging to 7 genera have been gathered by the author. For convenience, the genera and species are enumerated in the alphabetical order. Flowering and fruiting season follows the correct name of the species. The sedges collected during the course of the investigation run into 232 fields numbers and have been deposited in the herbaria of Panjab University, Chandigarh (collected during July 1963 to April 1966 and indicated by a single asterisk), Punjab Agricultural University, Ludhiana (collected during May 1966 to September 1968 and indicated by double asterisks) and Punjabi University, Patiala (collected since October 1968 and unmarked). Collector for all may be read as M. Sharma.

LIST OF SPECIES

Bulbostylis barbata Cl. Aug.-Sept. 2272*, 103**, 345, 1452, 1563, 2109.

Carex fedia Nees. Feb.-Apr. 2699*, 637**, 1843, 2804, 4252.

Cyperus alopecuroides Rottb. Throughout the year. 222**, 3227, 3724.

C. alulatus Kern. June-Sept. 2277*, 278**, 343, 941, 3732, 4013, 4334.

C. arenarius Retz. July-Sept. 2749*.

C. atkinsonii Cl. July-Oct. 2992, 3073, 3102.

C. brevifolius Hassk. Apr.-Nov. 2368*, 780*, 966, 2203, 2891, 2973.

C. bulbosus Vahl. July-Sept. 2740*, 102**, 341, 1448, 4283.

C. compactus Retz. July-Oct. 2780*, 946**, 775, 1506, 4032, 4322.

C. compressus L. July-Oct. 2273*, 225**, 342, 2869, 4347.

C. difformis L. July-Sept. 2270*, 136**, 379, 909, 1439, 1525, 2962.

C. digitatus Roxb. Aug.-Oct. 2266*, 314**, 2185, 2265, 5631.

C. eleusinoides Kunth. July-Oct. 2761*, 2246, 2949, 2985, 3766, 4329.

C. exaltatus Retz. July-Sept. 2118, 2167, 2210, 2296, 4637.

C. flabelliformis Rottb. Nov.-Mar. 427**, 5139.

C. globosus All. Mar.-Oct. 2267*, 781**, 913, 1361, 2284, 2495, 2504, 2825.

C. iria L. July-Oct. 2280*, 140**, 378, 912, 942, 1539, 2900.

C. kyllingia Endl. June-Sept. 2274*, 920, 2879, 2994, 3754.

C. laevigatus L. Mar.-Sept. 2350*, 1375, 2003, 2587, 2904, 3498.

C. michelianus Link subsp. *pygmaeus* Asch. & Graebn. Aug.-Sept. 815**.

C. niveus Retz. June-Sept. 2271*, 187**, 1460, 2874, 3589.

C. paniceus Boeck. var. *roxburghianus* Kuk. July-Sept. 2751*.

C. pumilus L. July-Sept. 2491*, 2995.

C. rotundus L. Throughout the year. 2269*, 148**, 322, 910, 1557, 3597, 4353.

C. sanguinolentus Vahl. Aug.-Oct. 2531, 4079.

C. serotinus Rottb. Aug.-Oct. 2276*, 3104, 3207, 3741, 4328.

C. squarrosus L. July-Sept. 2756*, 1517, 2116, 2195, 2993, 3746.

C. tenuispica Steud. Aug.-Nov. 1668, 4649.

C. triceps Endl. July-Sept. 2275*, 745**, 344, 993.

Eleocharis acutangula Sch. July-Oct. 3548, 3775.

E. atropurpurea Presl. Aug.-Nov. 2770*, 963**, 1436, 1532.

E. dulcis Hensch. Aug.-Oct. 2793*, 4638.

E. palustris R. Br. Mar-May. 542**, 1711, 1712, 2001, 2676, 3865.

Eriophorum comosum Nees. Mar.-May. 2268*.

Fimbristylis bisumbellata Bub. Mar.-Nov. 2451*, 353**, 949, 1655, 1849, 2038.

F. complanata Link. Aug-Oct. 895**.

F. dichotoma Vahl. July-Oct. 81**, 388, 971, 1000, 1376, 1484, 1534, 2093, 2289, 2494, 3576.

- *F. falcata* Kunth. June-Sept. 2734*, 738**, 994, 2053, 2867.
- *F. ferruginea* Vahl. July-Sept. 2279*, 193**, 2231, 2875, 2948, 3561.
- *F. miliacea* Vahl. Aug.-Oct. 988, 4533, 4629.
- *F. ovata* Kern. July-Sept. 199**, 1444, 1530, 2871, 3762.
- *F. quinquangularis* Kunth. Aug.-Oct. 2281*, 254**, 355**, 591, 1438, 1504, 2961, 3214.
- *F. schoenoides* Vahl. July-Sept. 2278*, 2249, 3551, 3773.
- *F. tenera* Roem. & Sch. var. *oxylepis* Cl. July--Sept. 2276*, 253**, 388, 1535, 5325.
- *Scirpus litoralis* Schrad. Mar.-Apr.; Oct.-Nov. 391**, 1897, 2649.
- *S. mucronatus* L. Mar.-Oct. 392**, 2187, 2518, 2588, 4247, 4327, 5661.
- *S. roylei* Parker. July-Nov. 2789*, 359**, 911, 1671, 3103, 3201.
- *S. supinus* L. Aug.-Nov. 2772*, 792**, 1633, 1676, 3592.
- *S. triqueter* L. July-Sept. 5328.
- *S. tuberosus* Desf. Mar.-Nov. 1674*, 224**, 1437, 1715, 2012, 3912.

Besides the listed species, the following 8 species have also been recorded from the erstwhile united Punjab by Clarke (1893-94), Ahmad (1954) and Parker (1960) and are likely to occur within the present boundaries of the state:

Cyperus conglomeratus Rottb., *C. esculentus* L., *C. michelianus* L., *C. nutans* Vahl, *Fuirena wallichiana* Kunth, *Scirpus articulatus* L., *S. juncoides* Roxb. and *S. squarrosus* L.

NEW RECORDS

A perusal of the relevant literature dealing with the plants of Punjab shows that *Cyperus atkinsonii* Cl., *C. bulbosus* Vahl, *Eleocharis acutangula* Sch. and *Scirpus triqueter* L. are the new plant records for Punjab plains.

ACKNOWLEDGEMENTS

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REFERENCES

AHMAD, S. (1954): Grasses and sedges of Lahore district. Lahore.

AIRY SHAW, H. K. (1973): J. C. Willis, A Dictionary of the flowering plants and ferns. Cambridge.

AITCHISON, J. E.T. (1868): Flora of Hushiarpur District of the Punjab. *J. Linn. Soc. Lond.* (*Bot.*) 11:17-22.

*———— (1869): A Catalogue of the plants of Punjab and Sindh. London.

BAMBER, C. J. (1916): Plants of the Punjab. Lahore.

CLARKE, C. B. (1893-94): Cyperaceae. In J. D. Hooker. The Flora of British India. Vol. 6. London.

COLLETT, H. (1902): Flora Simlensis. Calcutta and Simla.

*COVENTRY, E. M. (1901): A Catalogue of the trees and shrubs of the Punjab. Lahore.

EDGEWORTH, M. P. (1838): Botanico-agricultural account of the protected Sikh States. *J. Asiat. Soc. Bengal* 7: 751-766.

———— (1842): Note to the botanico-agricultural account of the protected Sikh States. ibid. 11: 26-27.

KASHYAP, S. R. & JOSHI, A. C. (1936): Lahore District Flora. Lahore.

PARKER, R. N. (1918): A forest Flora for the Punjab with Hazara and Delhi. Lahore.

———— (1960): Cyperaceae. In J. F. Duthie, Flora of the Upper Gangetic Plain and of the adjacent Siwalik and sub-Himalayan tracts. Vol. 2, repr. ed. Calcutta.

Sabnis, T .S. (1940): A Contribution to the Flora of the Punjab plains and associated hill regions. *J. Bombay nat. Hist. Soc. 42*: 124-149, ibid. 342-379, ibid. 533-586.

Sharma, M. (1974): A preliminary survey of the flora of Patiala District (Punjab). *Bull. bot. Soc. Bengal 28*: 69-74.

———— (1975): A systematic account of the cultivated flora of Punjab. ibid. *29*: 141-146.

———— (1977): Aquatic and marshy angiosperms of Punjab. *Bull. bot. Soc. Bengal 31*: 52-60.

———— & Sharma, O. P. (1974): A floristic account of Ludhiana District (Punjab). *Indian For.* 100: 209-215.

Sharma, O. P. & Sharma, M. (1966): Observations on the flora of Chandigarh and its neighbourhood. *Res. Bull. (N.S.) Panjab Univ.* 17: 371-405.

Stewart, J. L. (1869): Punjab Plants. Lahore.

Tiwari, S. D .N. & Maheshwari, J. K. (1964): The Cyperaceae of Madhya Pradesh. *Indian For. 90*: 147-159, ibid. 616-629.

* Originals not seen.

A POPULATION STUDY OF TWO SPECIES OF NON-HUMAN PRIMATES: *MACACA MULATTA* AND *MACACA RADIATA*[1]

RAGHUBIR SINGH PIRTA,[2]
P. PRAKASH & MEWA SINGH[3]

(*With two text-figures*)

A population of 1496 rhesus monkeys living in 38 groups, and a population of 664 bonnet monkeys living in 31 groups, was counted in the forests of Dehra Dun and the forests and the urban areas of Mysore respectively. The rhesus monkeys had a mean group size of 39.37 individuals, whereas the bonnet monkeys had a mean group size of 21.42. Significant differences were found in the group size, the adult male and the adult female sex ratios between the two species. The importance of population studies is discussed from two view points: a) the species- and the population-specific adaptations to a particular ecological niche, b) conservation of these two primate species.

INTRODUCTION

A population study of non-human primates is important for two reasons: First, the ultimate group size (Crook 1972) and the 'socio-economic sex ratio' (Carpenter 1934) in the groups of primates living in their natural environment are the adaptive social behaviour patterns to the ecological pressures, and so, are directly shaped by the evolutionary contingencies. Second, a few surveys on the populations of rhesus (Southwick *et al.* 1961a, b; Lindburg 1971; Neville 1968) and bonnet (Simonds 1965; Nolte 1955; Rahman and Parthasarthy 1969) monkeys were made in early and mid sixties. Since then, many noticeable environmental changes such as afforestation, agricultural expansion, unfavourable attitudes of the people toward monkeys, trapping of monkeys for experimental and hygienic purposes etc., have taken place. These drastic changes have threatened the very survival of these two monkey species. A new survey was required to be made on these species from the view point of conservation, as well as to study their group size and socioeconomic sex ratios with reference to the ecological forces.

STUDY AREAS AND METHODS

The present study was conducted in the years June to November, 1975, on rhesus and August to October, 1978, on bonnet. The study areas included 3 divisions of Dehra Dun forests viz., Eastern, Western and Siwalik (for rhesus), and Mudumalai and Bandipur wildlife sanctuaries and the roadsides in and around Mysore City (for bonnet) (Fig. 1).

The forests of Dehra Dun are moist decidu-

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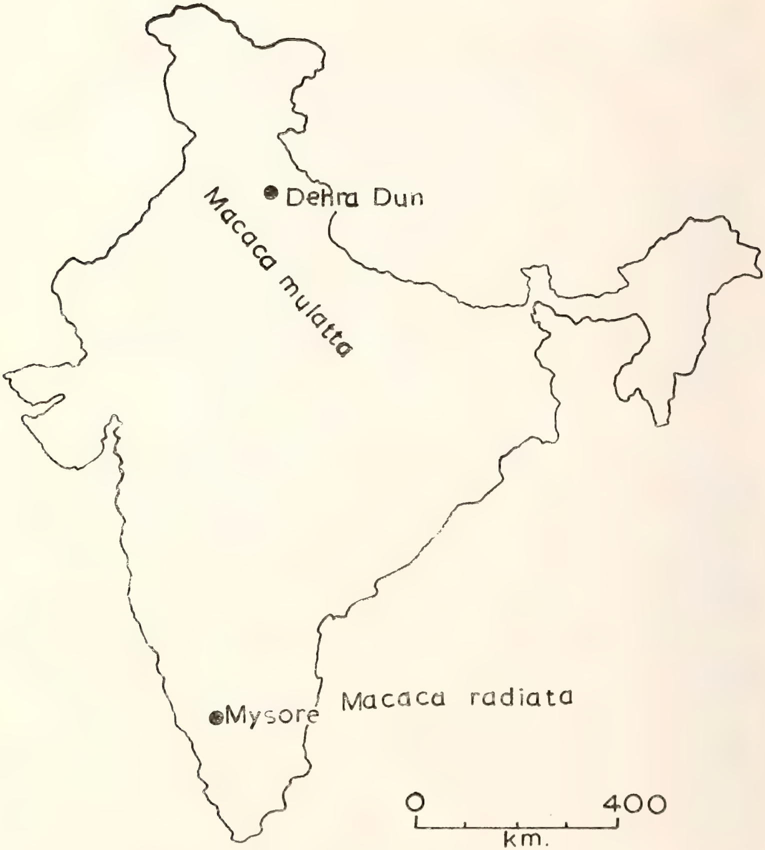
Dehra Dun
Macaca mulatta
Mysore
Macaca radiata
0
400
km.

Fig. 1. Map of India showing the locations of study areas.

ous type and mainly covered by sal (*Shorea robusta*) trees. Large mammals such as panther (*Panthera pardus*), tiger (*Panthera tigris*) and elephant (*Elephas maximus*) are rare, but spotted deer (*Axis axis*) and langur (*Presbytis entellus*) are common. In the forests of Mudumalai and Bandipur, elephant, tiger, panther, wild boar (*Sus scrofa*), gaur (*Bos gaurus*), wild dog (*Cuon alpinus*), spotted deer, sambar (*Cervus unicolor*)) and langur are common. Most of the bonnet groups were found outside the forest, inhabiting roadsides near agricultural areas covered with a thick vegetation of banyan (*Ficus bengalensis*), pipal (*Ficus religiosa*) and imli (*Tamarindus indica*) trees.

All these areas were visited on foot, and the monkeys were counted with naked eyes. The individuals were classified into four categories, i.e. adult male, adult female, juvenile, and infant (for the details of the basis of classification—see Southwick 1961; Pirta and Singh 1978).

RESULTS

A total of 1496 individuals were counted in 38 groups of rhesus monkeys, with a mean group size of 39.37. In bonnets, 31 groups were counted, with an average group size of 21.42 and a total of 664 monkeys. A comparative analysis of the group size for the two species yielded a significant difference (Table 1).

The per cent for each category of individuals was computed against the total animals of each group. A 't' analysis of significance was applied to compare the group composition for the two species. The mean per cent, 23.7 of males in bonnets was significantly higher than the mean per cent, 11.5 in rhesus ($P < .01$). On the other hand, the mean per cent, 26.9 for female bonnets was significantly less ($P < .01$) than the mean per cent, 32.0 for the rhesus female. A comparison of the mean percentages for juveniles and infants revealed nonsignificant difference between the two species (Table 2).

A significantly higher per cent of males in bonnets, and a significantly higher per cent of females in rhesus affected the socioeconomic sex ratio (adult male: adult female) of the two species, which was found to be 1:3.0 in rhesus and 1: 1.2 in bonnet monkeys (Fig. 2).

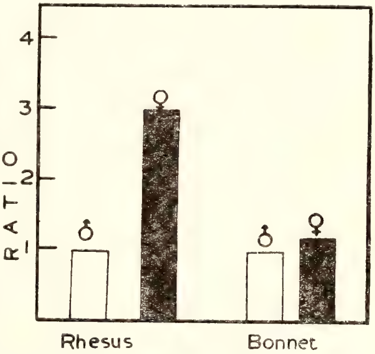

Fig. 2. Socioeconomic sex ratio (Adult male: adult female) in rhesus and bonnet macaques.

For the study of population dynamics, a bonnet group was observed for four years. Inspite of an average of 5 females breeding each year, the size of the group increased from 23 to 29 only, though, slight changes took place in the socioeconomic sex ratio (Table 3).

TABLE 1

DIFFERENCES IN GROUP SIZES OF RHESUS AND BONNET MONKEYS.

Species	No. of groups	No. of monkeys	Mean group size	't'	df	P
Rhesus	38	1496	39.37	4.67	67	0.01
Bonnet	31	664	21.42			

TABLE 2

DIFFERENCES IN GROUP COMPOSITION OF RHESUS AND BONNET MONKEYS.

Age/sex classes	Species	Mean% per group	't'	df	P
Adult ♂	Rhesus	11.5	6.89	67	0.01
	Bonnet	23.7			
Adult ♀	Rhesus	32.0	3.29	67	0.01
	Bonnet	26.9			
Juveniles	Rhesus	37.4	1.65	67	0.20
	Bonnet	33.1			
Infants	Rhesus	19.1	1.65	67	0.20
	Bonnet	16.3			

TABLE 3

HISTORY OF A BONNET GROUP.

Year	Group size	Adult males	Adult females	Juveniles	Infants	Socioeconomic sex ratio
Oct., 1974	23	4	5	9	5	1:1.2
June, 1975	27*	4	5	14	4	1:1.2
June, 1976	32!	10	6	11	5	1:0.6
June, 1977	29!*	8	7	11	3	1:0.8
Feb., 1978	5**	1	2	1	1	

* 5 monkeys left the group.

! 4 monkeys died when the group moved out of its home range.

!* The whole group was trapped except 5 individuals.

** These 5 monkeys were also not seen in the area after some time.

Discussion

It was found in the present study that the percentages of infants and juveniles were not different statistically between the two primate species. On the other hand, the percentages of adult males and adult females were significantly different—females constitute a larger part of the adult section of the group in rhesus, whereas the bonnet group contains an equal number of males and females. The male—female sex ratio in infant rhesus is found equal (Lindburg 1971). This indicates that there is no difference in the reproductive strategy of the two species. The less number of adult rhesus males may be due to the reason that during the process of development, a considerable number of males is eliminated from the group. On the other hand, the bonnet males enjoy an equal ratio with the females. Several investigators have indirectly attempted to explain this phenomenon. It has been reported that the kinship ties are stronger in bonnets than in rhesus (Rosenblum 1970). Pirta and Singh (1979) reported that many rhesus males, who leave the group, get wider knowledge of the habitat. If they join the natal group again, they will prove to be more efficient leaders. It may be possible that, because a less number of males is sufficient to inseminate a larger number of females, the extra males are thrown out of the group. But the last two explanations are not applicable in case of bonnet monkeys. Only a thorough investigation of the ecological forces and adaptations will explain such differences.

Similarly, another explanation is required for the differences observed in the group sizes of two different populations of the same species. A very interesting phenomenon was observed in the present study. The group size was larger in the interior forest areas (mean 48.0) than the areas near to human interaction (mean 31.0) in rhesus, whereas the bonnet were in larger groups in the urban and semi-urban areas (mean 22.8) than their forest counterparts (mean 13.8). These variations indicate that the group size, though, is a species-specific characteristic, it is prone to change according to the modification in the ecological niche. Predation, trapping, afforestation and the agricultural expansion may bring about significant variations in the group size. It seems that these factors have brought about the above mentioned population—specific (urban and forest) differences in group size. On the other hand, the differences in the group sizes of rhesus and bonnet living in the forest areas may be because of the differences in the energy requirement of the two species, though the energy yield of these forests may be same.

The present study, with reference to the old surveys made on rhesus and bonnet populations, reveals that the habitats of these species are changing tremendously. Southwick *et al.* (1961a) reported that 11% villages of Dehra Dun had resident monkey groups, but during our survey, no group was found in any of those villages. Siddiqi and Southwick (1975) found that "a population sample of rhesus monkeys in an agricultural area of western U.P. declined from 403 monkeys in 21 groups in 1962 to 197 monkeys in 11 groups by 1974." Similarly, Simonds (1965) reported some bonnet groups in the forest areas, some of which have totally vanished. In one group of Bandipur forest, 15 monkeys were observed two years before, and now there are only 5 animals. It was also observed that bonnet monkeys are very rare in the interior forest, and some groups which do live in jungle are found near tribal huts or the forest bungalows.

On the other hand, the changes taking place in the urban groups of bonnet are peculiar. A group was observed for four years, in which sudden increases or decreases of sex ratio were found. The pressures of the urban areas are quite different than those of the semi-urban, agricultural and the forest areas. However, the severity of these pressures is quite threatening to the survival of these monkeys irrespective of the habitat.

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REFERENCES

CARPENTER, C. R. (1934): A field study of the behaviour and social relations of howling monkeys. *Comp. Psycholo. Monog. 10*: 1-168.

CROOK, J. H. (1972): Sexual selection, dimorphism, and social organization in the primates. Sexual Selection and the Descent of Man. (B. G. Campbell Ed.).

LINDBURG, D. G. (1971): The rhesus monkeys in North India—An ecological and behavioral study. Primate Behavior (L. A. Rosenblum Ed.) Academic Press, New York, pp. 1-106.

NEVILLE, M. K. (1968): Ecology and activity of Himalayan foothill rhesus monkeys. *Ecology, 49*: 110-123.

NOLTE, A. (1955): Field observations on the daily routine and social behavior of common Indian monkeys, with special reference to the bonnet monkey (*Macaca radiata* Geoffroy). *J. Bombay nat. Hist. Soc. 53*: 177-184.

PIRTA, R. S. AND SINGH, M. (1978): Ecodevelopment of rhesus monkeys (*Macaca mulatta*) in the forests of Doon valley. Proceedings of the Workshop on Wild Life Ecology, F.R.I., Dehra Dun.

————, ———— (1979): Some factors affecting the size and location of home range in natural groups of rhesus monkeys (*Macaca mulatta*). *Pro. Ind. Acad. Sci.* (Animal Sciences). (in press).

RAHMAN, H. AND PARTHASARTHY, M. D. (1969): Studies on the social behavior of bonnet monkeys. *Primates,* 10: 149-162.

ROSENBLUM, L. A. (1970): Kinship interaction patterns in pigtail and bonnet macaques. *Proceedings 3rd Int. Congr. Primatol.* Zurich, 1970.

SIMONDS, P. E. (1965): The bonnet macaques in South India. Primate Behavior: Filed Studies of Monkeys and Apes, (I. DeVore ed.), Holt Rinehart & Winston, New York, pp. 175-196.

SIDDIQI, M. F. AND SOUTHWICK, C. H. (1975): Population trends and dynamics of rhesus in Aligarh District. Abstracts Winter School on Use of Non-Human Primates in Biomedical Research.

SOUTHWICK, C. H., BEG, M. A. AND SIDDIQI, M. R. (1961a): A population survey of rhesus monkeys in villages, towns and temples of North India. *Ecology, 42*: 538-547.

THE RELATIVE CONDITION FACTOR AND LENGTH-WEIGHT RELATIONSHIP OF A FRESHWATER CARP, *LABEO GONIUS* (HAM.) (CYPRINIDAE, TELEOSTEI)[1]

Anil Chatterji[2]

(*With five text-figures*)

INTRODUCTION

The relative condition factor (Kn) and length-weight relationship of a fish, *Labeo gonius* (Ham.) is reported here. These two factors are generally used for obtaining data on robustness, gonad development, time of spawning and the size at first maturity.

MATERIAL AND METHODS

The material for the present study were obtained from the commercial catch from River Kali at Aligarh from October, 1972 to October, 1973. Specimens ranging from 150-450 mm in length and 27-930 gm in weight were included in the present investigation. The analysis of relative condition factor and length-weight data was done using the methods given by LeCren (1951).

RESULTS

Variations in the values of relative condition factor in relation to size are presented in Figure 1. The value was found to be highest in smaller fishes of both sexes. High values were obtained upto 210 mm in males and 230 mm in females. The values increased and decreased alternately upto the length of 450 mm and three peaks and three valleys were obtained at the lengths of 210 mm, 330 mm and 390 mm in males, while at 310 mm, 370 mm and 430 mm in females (Fig. 1).

The gonado-somatic indices showed seasonal variation in both sexes. It started increasing from March and reached a maximum in May in case of males and June in case of females when the fish possessed fully ripe gonads. The gastro-somatic indices dropped suddenly in July and from July to February, it almost remained constant (Fig. 2).

There was a sharp increase in condition-with gonad from April to June while the condition-minus-gonad in females decreased considerably. The decrease in condition-with gonad during July and August was also very significant whereas, condition-minus-gonad did not show any remarkable decrease. No difference between condition-with-gonad and condition-minus-gonad was observed during rest of the year. A similar trend was noticed for males. Gastro-somatic index was found to decrease significantly from April to July in females. During rest of the months, the values were found to increase gradually in both sexes (Figs. 3 and 4).

Regression analysis on length-weight relationship along with the test of significance have been presented in Table 1 and the analysis of

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TABLE 1

STATISTICS OF REGRESSION OF LOG WEIGHT ON LOG LENGTH OF *L. gonius*

Source	Regression coefficient 'n'	S.S. due to regression	Residual S.S.	D.F.	Correlation coefficient	Observed 'T'	5% 't'	S
Male	3.1010	38.3750	3.6945	59	0.0375	2.0997	2.001	S
Female	3.0981	24.3953	3.8283	119	0.2669	1.9951	1.981	S
Juvenile	3.1322	26.3333	3.0166	13	0.5831	2.4861	2.160	S
Maturity stage— I Male	3.0030	1.3440	0.1633	18	0.6719	1.7403	1.101	NS
Maturity stage— I Female	3.0547	0.6868	0.0334	29	0.0815	0.4399	2.045	NS
Maturity stage— II Male	3.1568	0.9215	0.0383	8	0.2018	0.5396	2.306	NS
Maturity stage— II Female	3.0677	1.1559	0.0501	20	0.7704	1.5265	2.086	NS
Maturity stage— III Male	3.0140	1.1689	0.0627	11	0.0980	0.3408	2.201	NS
Maturity stage— III Female	3.3744	1.5398	0.0300	17	0.4400	1.0831	2.110	NS
Maturity stage— IV Male	3.6112	0.4898	0.0347	12	0.6441	1.7929	2.179	NS
Maturity stage— IV Female	3.6625	0.6592	0.0933	25	0.2608	1.3232	2.060	NS
Maturity stage— V Male	3.0734	0.5328	0.0254	5	0.6084	1.5332	2.571	NS
Maturity stage— V Female	3.0377	0.5774	0.0380	23	0.0785	0.3691	2.069	NS
Total within different maturity stages	3.0837	16.7605	7.9044	171	—	—	—	—
		DIFFERENCE	0.0307	10	—	—	—	—
Total between means of different maturity stages	3.1780	0.9038	0.0407	9	—	—	—	—
		TOTAL	7.9451	191	—	—	—	—
Combined (Male, Female and Juvenile)	3.7794	17.6643	7.9450	192	0.6316	11.2874	1.960	S
		DIFFERENCE	0.0001	1	—	—	—	—

S.S. = Sum of squares. D.F. = Degrees of freedom NS = Not significant S = Significant.

TABLE 2

ANALYSIS OF VARIANCE FOR DATA OF TABLE 1

Source	Sums of square	D. F.	Variance
Due to total regression	17.6643	1	17.6643
Between regression coefficient within different maturity stages	0.0307	10	0.0030
Difference between pooled within different maturity stages and means regression	0.0001	1	0.0001
Deviation of means from means regression	0.0407	9	0.0045
Residual	7.9450	171	—
Total	25.6808	192	—

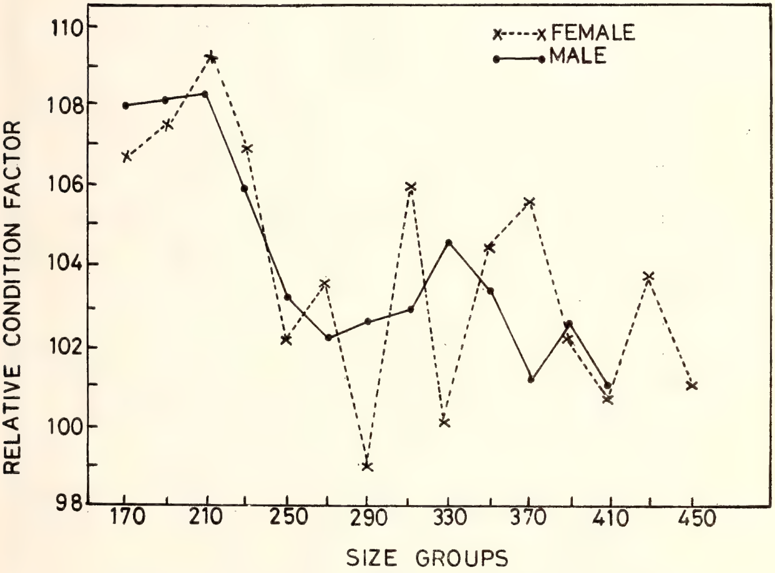

Fig. 1. Mean 'Kn' values at different size groups of *Labeo gonius*.

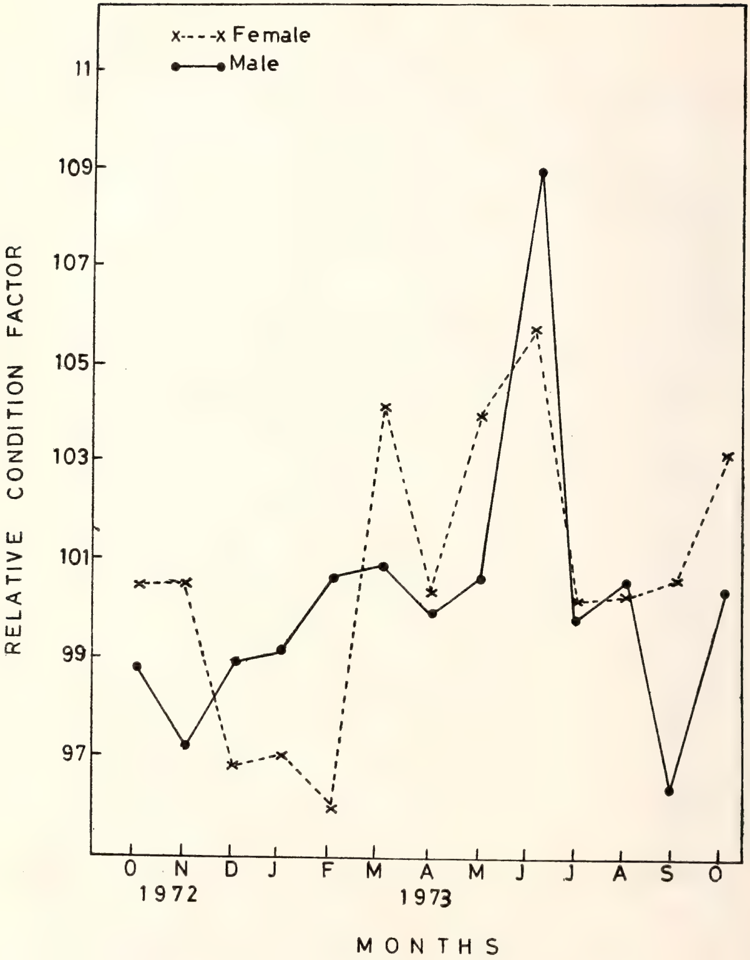

Fig. 2. Monthly variations in mean 'Kn' values of *Labeo gonius*.

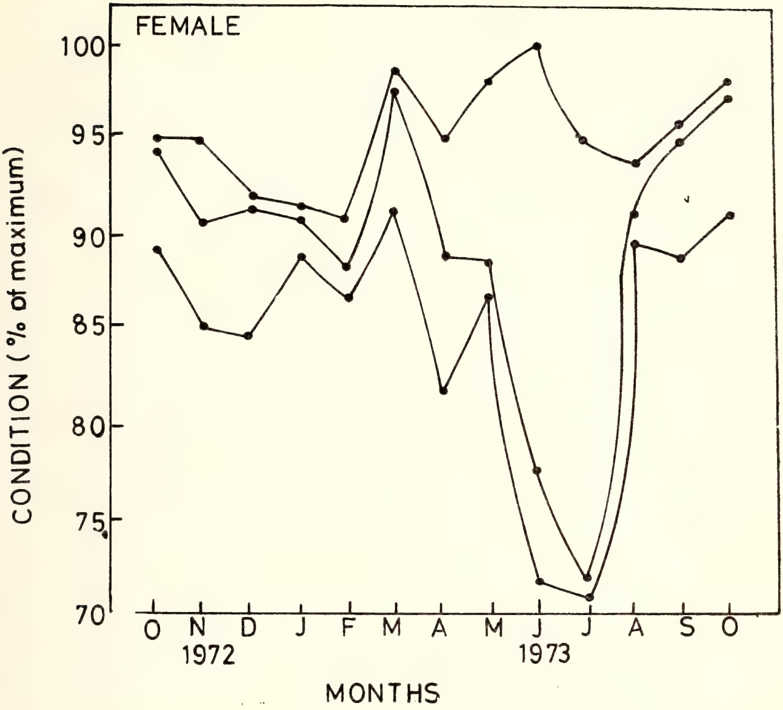

Fig. 3. Seasonal fluctuations in 'condition with gonad', 'condition minus gonad' and 'condition minus gonad plus gut' of *Labeo gonius* (Females).

variance for data in Table 1 is summerised in Table 2. The 'n' values ranged from 2.1995 (gutted females) to 3.0981 (ripe females) and 2.3693 (gutted males) to 3.1010 (ripe males). It was found to be highest in juveniles (3.1322) and lowest in females (3.0981). The calculation of 'n' values at 95% confidence limits for males, females and juveniles were always higher than 3 (Table 3). The length-weight relationships of males, females and juveniles are plotted in Figure 5a. It is quite clear from this figure that females were lighter than males upto a length of 245 mm, and heavier beyond it. The length-weight curves of the two sexes interesected at a point between 245-265 mm. Figure 5b shows the smooth curve of the length-weight relationship of combined fishes.

DISCUSSION

The present study showed that the fluctuations in relative condition factor of *Labeo gonius* (Ham.) in relation to size appear to be influenced by the number of spawnings

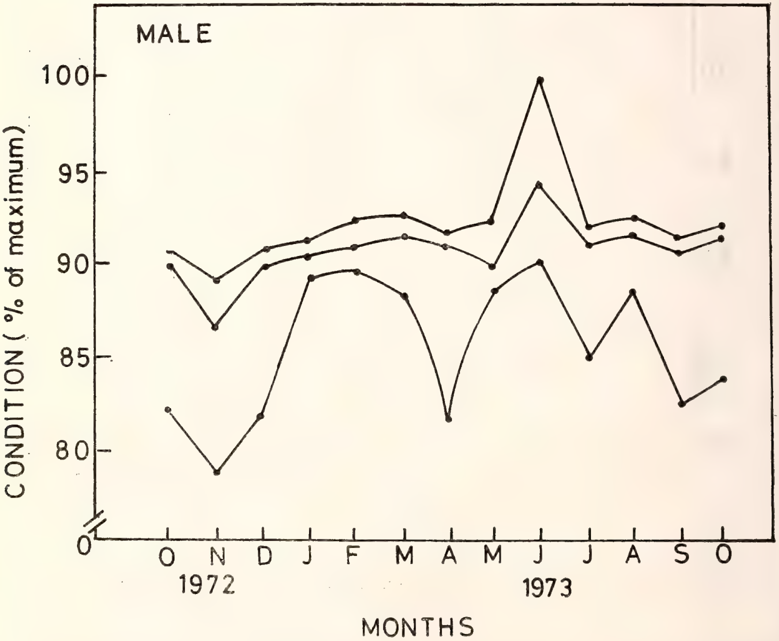

Fig. 4. Seasonal fluctuations in 'condition with gonad', 'condition minus gonad' and 'condition minus gonad plus gut' of *Labeo gonius* (Males).

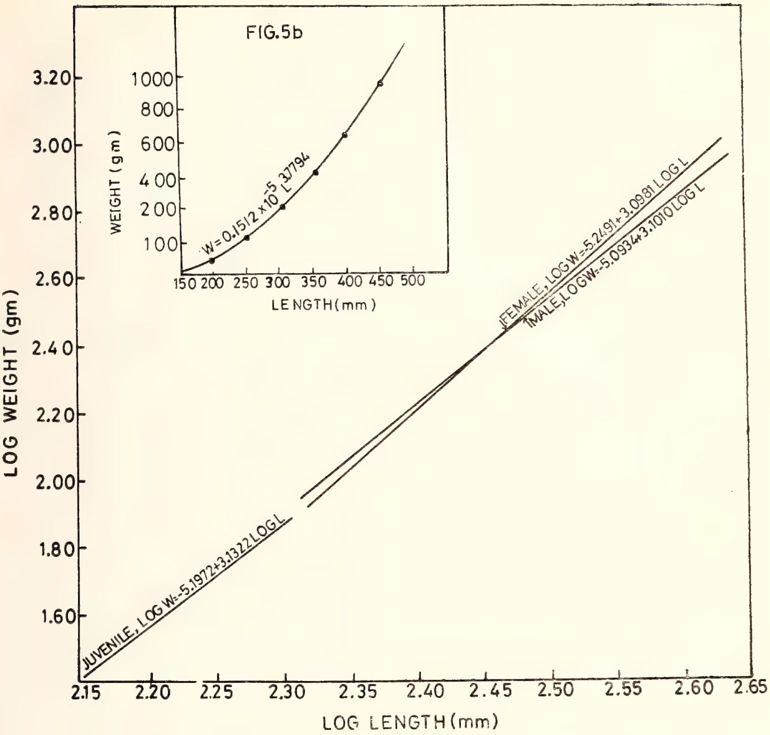

Fig. 5(a) The length-weight relationship of males, females and juveniles of *L. gonius*.
Fig. 5(b) The length-weight relationship of combined *L. gonius* (smooth curve represents the calculated weight).

that have taken place in six to seven years of life period. In this event the fish appeared to have spawned 3-4 times as the fish attains sexual maturity when it is about two years old. Therefore, the fish successively spawns each year (Chatterji *et al.* 1976, Siddiqui *et al.* 1976). Seasonal fluctuations in the relative condition factor were mainly due to maturation and depletion of gonads. Highest values were recorded when the fish was in ripe condi-

TABLE 3

REGRESSION EQUATION OF WEIGHT ON LENGTH OF *Labeo gonius* AND THEIR TEST OF SIGNIFICANCE

Source	Regression coefficient 'n'	Intercept of 'n'	Variance of 'n'	S.D. of 'n'	95% confidence limit of 'n'	S.E. of 'a'	Regression equation ($\text{Log } w = a + n \text{ Log } l$)	Parabolic equation ($W = a L^{n}$)
Male	3.1010	—5.0934	0.0414	2.2034	3.0492—3.1527	0.01738	$\text{Log } W = -5.0934 + 3.1010 \text{ Log } L$	$W = 0.8066 \times 10^{-5} L^{3.1010}$
Female	3.0981	—5.0491	0.0288	0.1697	3.0678—3.1284	0.00654	$\text{Log } W = -5.0491 + 3.0981 \text{ Log } L$	$W = 0.5635 \times 10^{-5} L^{3.0981}$
Juvenile	3.1322	—5.1972	0.0259	0.1611	3.0475—3.2169	0.01336	$\text{Log } W = -5.1972 + 3.1322 \text{ Log } L$	$W = 0.7995 \times 10^{-5} L^{3.1322}$
Combined	3.7794	—6.8205	0.0321	0.1792	3.7541—3.8046	0.00673	$\text{Log } W = -6.8205 + 3.7794 \text{ Log } L$	$W = 0.1512 \times 10^{-5} L^{3.7794}$

tion and lowest just after the spawning. Similar observations have been made in majority of the fish species which are seasonal breeders (LeCren 1951, Pillay 1953, Sarojini 1957, Pantulu 1963 and Chatterji *et al.* 1976). Some evidences are also available showing seasonal fluctuations brought about by feeding rhythm of the fish (Bal and Jones 1960, Blackburn 1960, Qayyum and Qasim 1964, Khan 1972 and Bhatt 1977). An increase in condition-with-gonad from April to June was due to the increased gonad weight and continued decrease in condition-minus-gonad indicated that certain amount of growth potential was sacrificed for gonad building. Since ovary weight increases enormously as compared to testes weight, this sacrifice was more pronounced in females than in the males.

The length-weight relationship of the fish did not follow the cube law as the values of slope 'n' were recorded always higher than 3 in the present case. Therefore, the weight of fishes increased more than the cube of the length. In some other carps a similar trend has been reported (Jhingran 1952, Chakrabarty and Singh 1963, Natarajan and Jhingran 1963, Bhatnagar 1972, Khan 1972, Ramamohana Rao and Hanumantha Rao 1972 and Chatterji *et al.* 1977). In small fishes, the observed weight was recorded lesser than the calculated weight while opposite was true for the larger fishes (Jhingran 1952, Chatterji *et al.* 1977).

In ripe fishes, the values of 'n' were higher whereas, in spent fishes, they were lower. During spawning period, the weight of the gonads increased considerably resulting in an increase in the total weight of the adult fish as well as a higher 'n' value. As soon as the fish discharged their gonad products the weight of the fish decreased resulting in a simultaneous decrease in 'n' value. Such changes in 'n' values reflect the onset of spawning season of the fish (Chatterji *et al.* 1977). The length-weight curve of males lies above the length-weight curve of females upto the length of 250 mm and beneath the length-weight curve of females afterwards. The point of intersection (between 250-265 mm) seems to represent the size at first maturity of the fish as reported by other workers also (Olsen and Merriman 1946, Natarajan and Jhingran 1963, Khan 1972 and Chatterji *et al.* 1977).

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REFERENCES

BAL, J. N. AND JONES, J. W. (1960): On the growth of brown trout of Llyn Tegid. *Proc. Zool. Soc. Lond. 134*: 1-41.

BATNAGAR, G. K. (1972): Maturity, fecundity, spawning and certain related aspects of *Labeo fimbriatus* (Bloch) of river Narmada near Hoshangabad. *J. Inland Fish. Soc. India 4*: 26-37.

BHATT, V. S. (1977): Studies on the biology of some freshwater fishes. Part-III *Heteropneustes fossilis* (Bloch). *Indian J. Fish. 15*: 99-115.

BLACKBURN, M. (1960): A study of condition (weight for length) of Australian Barracouda, *Thyrsites atun* (Euphrasen). *Aust. J. Mar. Freshw. Res. 11*: 14-41.

CHAKRABARTY, R. D. AND SINGH, S. B. (1963): Observations on some aspects of the fishery and biology of the mrigal, *Cirrhina mrigala* (Ham.) from Allahabad. *Indian J. Fish. 10*: 209-232.

CHATTERJI, A., SIDDIQUI, A. Q. AND KHAN, A. A. (1976): The relative condition factor of bata, *Labeo bata* (Ham.) from the river Kali, Uttar Pradesh. *Indian J. Anim. Res. 10* (2): 63-68.

———— (1977): Length-weight relationship of a carp, *Labeo bata* (Ham.). *Proc. Indian Acad. Sci. 86* (B): 189-194.

JHINGRAN, V. G. (1952): General length-width relationship of three major carps of India. *Proc. Nat. Inst. Sci. India 18*: 449-460.

KHAN, R. A. (1972): Studies on the biology of some important major carps. Ph.D. Thesis, Aligarh Muslim University, Aligarh.

LECREN, E. D. (1951): The length-weight relationship and seasonal cycle in gonad condition and weight in perch, *Perca fluviatalis*. *J. Anim. Ecol. 20*: 210-219.

NATARAJAN, A. V. AND JHINGRAN, A. G. (1963): On the biology of *Catla catla* from the river Jamuna. *Proc. Nat. Inst. Sci. India 29*: 326-355.

OLSEN, Y. H. AND MERRIMAN, D. (1946): Studies on the marine resources of Southern New England. IV. The biology and economic importance of the ocean trout, *Macrozoarees americanus* (Bloch and Schneider). *Bull. Bingham Oceanogr. Coll. 9*: 1-184.

PANTULU, V. R. (1963): Studies on age, growth, fecundity and spawning of *Osteogneiosus militaris* (Linn.). *J. Cons. int. Explor. Mer. 28*: 295-315.

PILLAY, T. V. R. (1953): Studies on food and feeding habits and alimentary tract of the grey mullet. *Mugil tade* (Forskl.). *Proc. Nat Inst. Sci. India 19*: 777-827.

QAYYUM, A. AND QASIM, S. Z. (1964): Studies on the biology of some freshwater fishes. I *Ophicephalus punctatus* (Bloch.) *J. Bombay nat. Hist. Soc. 61*: 74-98.

RAMAMOHANA RAO, G. AND HANUMANTHA RAO, L. (1972): On the biology of *Labeo calbasu* (Ham.-Buch.) from the river Godavari. *J. Inland Fish. Soc. India 4*: 74-86.

SAROJINI, K. K. (1957): Biology of grey mullet of Bengal. I-Biology *Mugil persia*. *Indian J. Fish. 4*: 160-207.

SIDDIQUI, A. Q., CHATTERJI, A. AND KHAN, A. A. (1976): Reproductive biology of the carp, *Labeo bata* (Ham.) from the river Kali, India. *Aquaculture 17*(1): 181-191.

SOME ASPECTS OF THE LIFE HISTORY OF BLACKBUCK IN NEPAL[1]

JOHN F. LEHMKUHL[2]

Blackbuck antelope (*Antilope cervicapra* L.) were considered extinct in Nepal until 1975 when 2 small remnant populations were found in the Banke and Bardia districts of the western Terai. Observations of these blackbuck were made from 1 October 1976 to 27 January 1977 to determine population status, behavior patterns, habitat use, and preservation options. This report describes population numbers, daily activity patterns, breeding seasons, territoriality, and food habits.

INTRODUCTION

In Nepal, the blackbuck was commonly found in the eastern and western Terai, an extension of the Gangetic Plain lying along the base of the Himalayan foothills. Until recently, blackbuck were considered extinct in both areas. Reports by Dinerstein (1975) and Wegge and Wilson (1976) revealed the existence of two small remnant populations in the Bardia and Banke districts, respectively, of the western Terai. This report describes aspects of the life history of blackbuck in the 2 remnant populations, obtained from a larger study to determine the status of blackbuck in Nepal and the means for their preservation as part of Nepal's unique fauna.

METHODS

The Bardia population was observed from 18 to 30 October 1976 and from 22 to 27 January 1977. The Banke population was studied from 3 to 10 November 1976 and from 7 to 13 January 1977.

Observations were made on foot, except in Bardia, where an observation platform was built in a tree that was centrally located in the dominant male's territory. Population estimates were made from simultaneous sightings, individual recognition, and by drives where appropriate. Binoculars of 7 × 35 power and a 20 × telescope were essential for observing the animals.

Study Area

Bardia: The Bardia area, about 2.6 km², is situated approximately 4 km north of the town of Gularia, in a bend of the old Babai River bed, near the village of Kaidi. A blackbuck protection guard post, operated by the Forest Department, is situated there.

Standing water is found in the old River bed during most of the year, but dry areas appear in many places during the hot season of March to June. The area is mostly marginal agricultural land and grazing land bordered on three sides by the old river bed and on the other side by scrub jungle.

The agricultural land consists of a patchwork of fallow and cultivated fields, the major crops being corn (*Zea mays*), wheat (*Triticum aestivum*), rahar dal, mas dal (*Lens esculenta*), musoori dal (*Phaseolus mungo*), mustard (*Brassica campestris* or *B. junceae*), and peanuts (*Arachis hypogaea*). Rice (*Oryza*

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sativa) is not a major crop as the soil is sandy and porous. Rahar dal is the major and most conspicuous crop because of its height (up to 2 m), dense growth, and persistence throughout the year.

Vegetation on fallow fields varies with the intensity of the livestock grazing regime, which is determined by the size of the area and the nearness of standing crops that may be damaged by livestock. Short-cropped dub grass (*Cynodon dactylon*), and the forbs chamcham (*Cassia tora*) and ganja (*Cannabis sativa*) form an herbaceous layer in large (greater than 1 ha), agriculturally unproductive, heavily grazed fields. Ber (*Zizyphus mauriteous*), a thorny shrub, is dense in heavily grazed areas with relatively little past cultivation.

The small (less than 1 ha) fallow fields are generally more productive and less heavily grazed than the larger fields, and are interspersed in a patchwork fashion with standing crops. The following short graminoids dominate: *Eragrostis coercta; Panicum* spp. (2); *Paspalum distichum; Eleusine indica; Setaria glauca; Thylactodenia aegyptum; Fimbristylis* sp.; *Cyperus* sp.; *Chrysopogon asciculatus; Saccharum munja;* and *Sporobolus diander* (Dinerstein 1975). These graminoids, spared from grazing, form a thick mat under the rahar dal plants.

In the jungle to the northeast, simal (*Bombax malabaricum*) dominates, but khair (*Acacia catechu*) and sissoo (*Dalbergia sissoo*) are also found. The understorey is dominated by dense clumps of ber with an herbaceous layer of chamcham and heavily grazed grasses. The canopy cover is rather open, but visibility is restricted in the understorey by ber.

Banke: The Banke area is situated about 37 km southeast of Nepalganj, between the Rapti River and the Dudwa Range, near the villages of Jamuni and Bhaghawanpur. It is mostly open, cultivated land with a few scattered clumps of mango trees covering roughly 8 km^2. The Rapti River makes a wide annual floodplain of sandy flats vegetated mainly by *Tamarix indica* and short annual graminoids. Floodplain areas subject to periodic flooding are partly covered with a tall grass, *Vetiveria zyzanoides*. Order parts of the area are used as transient grazing and crop lands.

Rice is practically the sole crop, with mustard, wheat, and various types of dal of limited importance. During the hot season, the fields are not cultivated, but cattle graze on what little vegetation remains.

The jungle along the base of the Dudwa Range has been heavily affected by grazing and woodcutting. The dense growth of thorny and unpalatable shrubs, that dominates the first few hundred metres from the edge of the croplands, is the result of this disturbance. Beyond the first few hundred metres, the understorey opens into small glades of 0.04-0.2 ha. These "dhoenias" are characterized by large dhoe trees (*Lagerstroemia parviflora*) with large clumps of ber, short grasses, and chamcham below. Dhoenias are distributed patchily throughout the jungle up to the base of the hills.

RESULTS AND DISCUSSION

Population Estimates

Bardia: In the Bardia area, 11 blackbuck were sighted by myself or forest guards (3 adult males, 1 two-year-old male, 1 yearling male, 3 adult females, 1 yearling female, and 2 fawns).

Banke: Estimating the number of blackbuck in the Banke area was difficult because of unharvested rice in the agricultural areas during 1976. In addition, the nocturnal behavior of the animals hindered observations in 1977. Simultaneous sightings of 5 females (3 adults and 2 yearlings), and 1 adult male were made by myself and villagers during 1977. Other villagers reported seeing, at different times, 2 groups of 6-7 blackbuck, with 1-2 adult males in each group. Whether these groups represent different animals is difficult to say; I observed females ranging widely throughout the area.

From the above information, a minimum of 7 blackbuck used the Banke area. Wegge and Wilson (1976) only saw 2 blackbuck, but they concluded from local interviews that 15-20 blackbuck used the area during 1976. Villagers confirmed this estimate, but said that blackbuck were extremely scarce in 1977, and they could not give an estimate of blackbuck numbers. Some villagers speculated that the 1976 monsoon flooding of the Rapti River had driven the animals to India, 1.5 km to the south.

Daily Activities

Bardia: The blackbuck in Bardia, being less disturbed than those in Banke, were more easily observed. The 4 bachelor males were usually seen feeding and interacting in open pastures and fields outside the dominant male's territory, during evenings and early mornings. Toward midmorning, when farmers and cattle became active, the bachelor males moved to cultivated areas where cover, in the form of rahar dal and corn, was better.

Similarly, the main group (the dominant male, 2 adult females and their fawns, and the yearling female) was seen feeding in large fields (greater than 1 ha) during the evenings and early mornings, when human disturbance was least. During the day, the group stayed in an open, about 0.5 ha, fallow field feeding, interacting, and resting. Upon being disturbed, they would escape to the dense rahar fields that surrounded the open field on 3 sides; 15-30 minutes after the disturbance ended, the group would come into the open, usually the dominant male first, and remain until disturbed again.

Banke: Because of the limited number of observations on Banke blackbuck, little is known about their daily habits. The 4 females were observed 4 times in the fallow fields near the forest edge before sunrise. Twice they were seen travelling across the open fields from the direction of the Rapti floodplain, some 2 km distant. Immediately after sunrise, the females moved into the scrub jungle, where they presumably stayed all day to avoid contact with farmers, hunters, and cattle. Apparently, after nightfall they returned to the fields to feed.

Breeding Season

Bardia: On 20 October, in Bardia, 1 of 2 adult females appeared to be pregnant. On 23 October, a new fawn was seen with the group, probably having been born to this female a day or 2 before. On 26 October, a second 1-2 day old fawn was seen with the group.

Three instances of rutting behavior, such as nose-up display (nose up and horns parallel with the back), chasing, and attempted mounting were observed in October. The 2 females that were courted had just given birth and were not receptive to the male's approaches. Copulation was not observed.

Banke: Villagers in Banke said that fawns were born in February and March. A villager raised a male blackbuck that was found as a newborn in February.

Although males are sexually active at all times of the year (Schaller 1967), rutting peaks are caused by the availability of estrous females, which is influenced by fawning peaks; these peaks, in turn, are influenced by seasonal changes in environmental conditions that influence fawn mortality (Mungall 1978). Mungall stated that females are polyestrous throughout the year until bred; thus, in the absence of environmental extremes, fawning, and therefore breeding, occurs throughout the year.

Records of 125 blackbuck born in the London zoo (Jarvis and Morris 1962, cited in Schaller 1967) indicate no birth peaks. Schaller (1967), working with wild Indian blackbuck in Kanha Park, reported that 1 fawn was born during September, and 12 were born between February and April. Conversely, at Sikandra, near Agra, he noted that 16 fawns were born between August and September, and only 3 were born in February. Some births were noted at all times of the year.

With a 5-6 month gestation period (Brown 1936, Asdell 1946, and Mungall 1978), the fawns in Bardia were conceived during late April. This agrees with Schaller's (1967) data for Sikandra; but, for Kanha, he reported a minor peak in April, and a more intense peak from August to October. Lydekker (1924), Asdell (1946), and Prater (1948) reported the main rutting season as February and March.

By looking at seasonal environmental changes occurring in Nepal and northern India, one can discern some advantages of the February to April rutting peak observed in this study, and predominantly reported in the literature. A female is bred in March, and early gestation, the least energy demanding period of gestation (Moen 1973), proceeds during the hot dry season when forage quality is low and heat stress is high. Precipitation increases with the approach of the monsoon rains in June, causing a flush of new vegetation at the same time as energy demands of gestation become greatest. Good conditions prevail throughout the monsoon, which ends by the end of September. Fawns are born in October and mature during the mild winter season when abundant, nutritious forage is available to the lactating mother.

Breeding and fawning during other times of the year would appear disadvantageous, with respect to availability of nutritious forage and favourable climatic conditions, for late gestation, lactation, and post-lactation fawn survival. Nevertheless, Schaller (1967), for Kanha Park, reported a higher fawning peak from February to March, than for August to October, while some births occurred throughout the year.

Seasonal changes apparently do not strongly limit the breeding cycle of blackbuck, as they do with ungulates in more extreme north temperate climates. Indeed, Schaller proposed the same hypothesis, and noted that sexual cycles of other Indian ungulates, such as chital (*Axis axis*) and barasingha (*Cervus duvauceli*), varied from area to area, seemingly in response to local environmental conditions.

Territoriality

Bardia: Of the 3 adult males, only 1 had established a territory. Another adult male, a 2-year-old, and a yearling formed a bachelor herd that roamed the area along the periphery of the territory. Forest Department guards said that the third adult male ranged widely throughout the area with an adult female. The other 3 females and the 2 fawns were not observed outside the territory of the dominant male.

Mungall (1978) reported that females, in

Texas, travel a daily circuit, with a male attending them as they pass through his territory. Schaller (1967), working in India, found that does stayed with a territorial buck from February to November; during December and January, the breeding groups disbanded, and the blackbuck congregated in mixed groups. He noted, though, that the 2 breeding groups in Kanha Park stayed intact during the entire year. He hypothesized that variations in the pattern of social behavior may occur with small populations; in the absence of contiguous territories and competition for does, breeding groups may remain intact for longer periods. Apparently, that is the case for Bardia blackbuck; low numbers of animals and restricted range of movement has resulted in a stable breeding group.

The dominant male marked his territory by sniffing, pawing, urinating, and defecating at established dung piles. He also marked bushes and tall forbs with scent from his preorbital glands, and thrashed small bushes with his horns. The territory covered 36-40 ha; about 10 ha were planted with rahar dal, the rest was mainly pasture with some fields planted with mas dal.

On 2 occasions, the dominant male was seen chasing other males from his territory. Once, the 2-year-old and the yearling of the bachelor group were feeding in the dominant male's territory; the dominant buck approached them through the cover of a rahar dal field and, after entering the open, immediately began chasing the yearling at full speed. The chase lasted approximately 5 minutes and covered about 1 km, ending in the bachelor males' area. The 2-year-old trotted back to the same area. The second time, the yearling was feeding with the females in the dominant male's territory; the dominant male again approached through a dal field and gave chase in the manner described above.

No territorial challenges were observed. The dominant male was seen several times with the bachelor group during early mornings. Once, he sparred with the adult bachelor male for approximately 2 minutes; after sparring, the dominant male stotted a short distance and trotted back to his territory. The bachelor males continued to spar intermittently for about 15 minutes, a third male often attempting to mount one of the sparring males.

Banke: Since I did not see any males in Banke, little can be said of their social behavior. Probably, normal patterns of social behavior are severely disrupted because of low numbers of blackbuck and the high degree of disturbance there.

Food Habits

Blackbuck in both areas depended heavily on agricultural crops for food. Villagers reported that blackbuck ate rice, mas dal, wheat, and mustard. Table 1 shows the main crops found in the blackbuck areas and their seasonal availability as food items.

Schaller (1967) reported that short grasses, such as *Chrysopogon, Paspalum,* and *Sporobolus,* composed the bulk of the diet, in Kanha Park. Young shoots of tall grasses, *Themeda* and *Vetiveria,* were eaten after burning. He noted that blackbuck were frequently associated with agricultural areas. Habitat displacement was a major reason for this behavior; nevertheless, blackbuck probably favored those areas because of the short graminoids associated with early successional stages resulting from heavy livestock grazing and agriculture.

Preference for early successional stages is an important consideration for blackbuck

TABLE 1

MAIN CROPS OF THE BLACKBUCK AREAS AND THEIR SEASONAL AVAILABILITY AS FOOD ITEMS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice						×	×	×	×	×	×	
Corn					×	×	×					
Wheat	×	×	×								×	×
Mas dal	×	×	×									×
Rahar dal	×	×	×				×	×	×	×	×	×
Musoori dal	×	×	×									×
Mustard	×										×	×
Peanuts									×	×	×	

habitat management. According to Puri (1960), in northern India short-grass types are maintained by heavy grazing and periodic fires. In the absence of grazing, large unbroken stands of *Imperata cylindrica*, a relatively unpalatable 0.5-1 m high grass, develop and are maintained by periodic fires. Where edaphic conditions are not limiting, eliminating fire leads to grasslands dominated by tall grasses (2-3 m), such as *Phragmites* and *Saccharum*. Succession can be reversed to favor short grasses by burning and mechanically breaking *Imperata* stands, making the area more suitable for grazing animals such as blackbuck.

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REFERENCES

ASDELL, S. (1946): Patterns of Mammalian Reproduction. Ithaca, New York.

BROWN, C. (1936): Rearing wild animals in captivity, and gestation periods. *J. Mammal. 17*: 10-13.

DINERSTEIN, E. (1975): A second status report on Nepal's most endangered species, the blackbuck of Bardia. National Parks and Wildlife Conservation Office, Kathmandu. Mimeo report, 2 pp.

JARVIS, C. AND MORRIS, D. (eds). (1962): The international zoo yearbook. Vol. III. London.

LYDEKKER, R. (1924): The Game Animals of India, Burma, Malaya, and Tibet. London.

MOEN, A. N. (1973): Wildlife Ecology: An Analytical Approach. W. H. Freeman and Co., San Francisco.

MUNGALL, E. C. (1978): The Indian blackbuck antelope: a Texas view. *Kleberg Studies in Natural Resources*, No. 3, 184 pp.

PRATER, S. H. (1948): The Book of Indian Animals. Bombay Natural History Society, Bombay.

PURI, G. S. (1960): Indian Forest Ecology. Oxford Book and Stationary Co., New Delhi.

SCHALLER, G. B. (1967): The Deer and the Tiger: A Study of Wildlife in India. University of Chicago Press, Chicago.

WEGGE, P. AND WILSON, P. (1976): The blackbuck of Banke district. National Parks and Wildlife Conservation Office, Kathmandu. Mimeo report, 5 pp.

MATERIALS FOR THE FLORA OF MAHABALESHWAR[1]

P. V. Bole[2] and M. R. Almeida[3]

Mahabaleshwar is the most popular hill-station of Maharashtra and sometimes referred to as the queen of the Western Ghats. It is situated at about 17° 56′N. latitude and 73° 40′E. longitude, at an altitude of 1300 metre. It receives 690 cm average rainfall and more than 95% of it is restricted to four months of the year, June to September. While the maximum temperature hardly ever touches 32°C, the minimum is seldom below 13°C. The meteorological and other ecological data pertaining to the hill-station is proposed to be given in the form of an appendix in the last instalment of this contribution.

There have been several contributions to the floristics of Mahabaleshwar but a comprehensive study of flora still remains to be provided. Therefore in this work we intend to furnish an up-to-date list of flowering plants. Our studies are based on collections by the late Rev. Fr. H. Santapau and of the senior author who has spent more than ten years in the study of the flora of this area.

We invite corrections, deletions or additions to the information provided here which will be gratefully acknowledged if and when the FLORA OF MAHABALESHWAR is published in book form.

The materials on which these observations are based, are preserved in the Blatter Herbarium, except in the cases where it is stated otherwise.

We list below the publications which we have referred very frequently. Other references are cited as per standard practice in the text wherever necessary.

Birdwood, H. M. (1886): A Catalogue of the Flora of Matheran, in *J. Bombay nat. Hist. Soc. 1*: 203-214.

——— (1887): A Catalogue of the Flora of Mahabaleshwar and Matheran, ibid. *2*: 107-132.

——— (1896): A Catalogue of the Flora of Matheran and Mahabaleshwar, ibid. *10*: 394-439.

——— (1897): A Catalogue of the Flora of Matheran and Mahabaleshwar. (Rev. Ed.) (Bombay).

Blatter, E. and Blatter, E. & McCann, C. (1926-1932): Revision of the Flora of the Bombay Presidency, (22 parts). *J. Bombay nat. Hist. Soc.* vols. 31-36.

Cooke, T. (1885): List of the principal Mahabaleshwar plants, Appendix-A, in Bombay Gazetteer, vol. 19 (Satara): 647-652.

——— (1887): Note on the Flora of Mahabaleshwar and Matheran, in *J. Bombay nat. Hist. Soc. 2*: 133-140.

——— (1896): Supplementary note on the Flora of Matheran and Mahabaleshwar, ibid. *10*: 440-448.

——— (1901-1908): The Flora of the Presidency of Bombay, vols. I-II. (London) (Reprinted ed. vols. I-III, Calcutta, 1958).

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DALZELL, N. A. & GIBSON, A. (1861): The Bombay Flora...together with a supplement of introduced species. (Bombay).

GRAHAM, J. (1839): A Catalogue of the Plants growing in Bombay and its Vicinity. (Bombay).

HOOKER, J. D. (1872-1897): Flora of British India (FBI), vols. I-VII.

LEE, H. H. (1885): List of Plants of Mahabaleshwar, Appendix-A, in Bombay Gazetteer, vol. 19 (Satara), 625-646.

LISBOA, J. C. (1883): List of the Plants seen at Mahabaleshwar at the end of the last hot season, in *J. Royal Asiat. Soc.* (*Bombay*) *15*: 203-224.

MARKHAM, C. R. (1862): Travels in Peru and India. (London).

NAIRNE, A. K. (1894): The Flowering Plants of Western India. (London and Bombay).

PURI, G. S. & MAHAJAN, S. D. (1960): The Study of the evergreen vegetation of Mahabaleshwar area. *Bull. Bot. Surv. India,* 2 (1 & 2): 109-137.

SANTAPAU, H. (1953): Excursion Botanica a Mahabaleshwar, in *Anales Del, I. Botanico, A. J. Cavanilles 1* (11): 281-317.

———(1962): The Botanical Exploration of Mahabaleshwar. *Proc. Summer School of Bot.*: 395-400.

——— (1967): The Flora of Khandala on the Western Ghats of India, (3rd Ed.) (Delhi).

TALBOT, W. A. (1909-1911): Forest Flora of the Bombay Presidency. vols. I-II. (Poona).

VARTAK, V. D. (1962): Some imperfectly known Plants from Poona and Satara Districts, in *J. Univ. Poona* (*Sci. & Tech.*) *10*: 5-12.

——— (1970): Some Imperfectly known Plants from Poona and Satara Districts—Part II. ibid. *18*: 77-98.

WIGHT, R. (1840-1850): Illustrations of Indian Botany. vols. I-II (London).

——— (1838-1858): Icones Plantarum Indiae Orientalis, vols. I-VI. (Madras).

WIGHT, R. & WALKER-ARNOTT, G. A. (1834): Prodromus Florae Peninsulae Indiae Orientalis. (London).

WOODROW, G. M. (1897-1901): The Flora of Western India (8 parts). *J. Bombay nat. Hist. Soc.* vols. 11-13.

RANUNCULACEAE

1. Climbing shrubs, leaves opposite .... *Clematis*
1. Erect herbs, leaves alternate............ .... *Thalictrum*

Clematis Linn.

1. Leaves glabrous except the young parts; flowers white or greenish white..............2
    2. Flowers exceeding 2 cm in diameter...... .... *C. triloba*
    2. Flowers less than 2 cm in diameter.......3
        3. Connective of anthers not produced.... .... *C. gouriana*
        3. Connective of anthers much produced... .... *C. hedysarifolia*
1. Leaves silky villous on both surfaces; flowers yellow .... *C. wightiana*

1. **Clematis triloba** Heyne ex Roth. Nov. Pl. 251, 1821; Dalz. & Gibs. 1; FBI 1: 3; Nairne; 6; Lisboa: 208; Cooke 1: 2(2); Talbot 1: 3.

Included on the authority of Lisboa and Birdwood. However while discussing the occurrence of this species at Mahabaleshwar with Rev. Fr. H. Santapau, he mentioned that he had seen it once on the slopes of Fitzgerald Ghat, but he could not collect a specimen in spite of his best efforts. No authentic specimen from Mahabaleshwar is available.

LOCAL NAMES. *Morvel, Ranjai* (Lisboa).

2. **Clematis gouriana** Roxb. ex DC. syst. 1:

138, 1818; Graham, 1; Dalz. & Gibs.: 1; FBI 1: Nairne: 5; Birdwood: 6; Cooke 1; 2(2); Puri & Mahajan; 119.

Highly decorative plant when in flowers or fruits. Common on slopes of Fitzgerald Ghat and along the fringes of forests. 10-20 m long and sometimes reaching the canopy of the trees, especially at an altitude ± 1000 m.

Fitzgerald Ghat.

FLOWERS. November-December; FRUITS. December-March.

LOCAL NAME. *Morvel.*

3. **Clematis hedysarifolia** DC. Syst. 1: 148, 1818; FBI. 1: 4; Birdwood: 6; Cooke 1: 2(3); Talbot 1:1; A. S. Rao, *in* Bull. Bot. Surv. India 6(1): 19-21, 1964; Santapau. *in* Bull. Bot. Surv. India 6(1): 59-69, 1964.

Found on slopes of Fitzgerald Ghat along with the preceding species but is not as common. Flowers, when fresh, are white and rather attractive and fruits are very conspicuous and persistent.

Often confused with preceding one but could be distinguished from it by its much produced connectives. However in the herbarium this species could be easily separated as it has strongly reticulate veins and more coriaceous texture in dried leaflets.

Fitzgerald Ghat, Koyna Valley.

LOCAL NAME. *Bendrichi vel* (Cooke).

FLOWERS. October-November; FRUITS. November-May.

4. **Clematis wightiana** Wall. ex Wight et Arn. Prodr.: 2, 1834; Grahm; 1; Dalz. & Gibs.: 1: FBI 1: 5; Nairne: 5; Cooke: 648; Birdwood: 6; Cooke 1: 3(3); Talbot 1: 6; Puri & Mahajan: 119; Santapau; 305.

This is the commonest species of *Clematis* confined to higher elevations. The entire plant is generally covered with villous, shining, silky hairs. An ornamental climber worthy of introduction in tropical gardens.

LOCAL NAME: *Morvel.*

FLOWERS. November-January: FRUITS. December-March.

Thalictrum Linn.

1. Stipules oblong, membranaceous; achenes narrow, oblong .... *T. dalzellii*
1. Stipules fimbriate; achenes compressed .... *T. obovatum*

1. **Thalictrum dalzellii** Hook. Ic. Pl. 9: t. 868, 1852; Dalz. & Gibs.: 2; Cooke 1; 4(4); V. D. Vartak: 77, t. 1.

Known from Mahabaleshwar from only one collection by Mr Laxman (V. D. Vartak).

FLOWERS. August.

2. **Thalictrum obovatum** Blatter, in J. & Proc. Asiat. Soc. Bengal (N.S.) 26(1): 339-40, 1930.

A rare species, only known from type collection. According to Blatter it is allied to *T. dalzellii* Hook., from which it differs due to its consulcate stem, fimbriate stipules, broadly obovate and anguiculate sepals which are also shorter than stamens, flattened filaments and distinctly stipitate and compressed ovary.

The type of this species (E. Blatter: P-26), collected half way between Mahabaleshwar and Panchgani is deposited in the Blatter Herbarium (BLAT).

FLOWERS & FRUITS. July.

DILLENIACEAE

Dillenia Linn.

1. **Dillenia pentagyna** Roxb., Corom. 1: 21, t. 20, 1795; Birdwood: 6; 1897.

Besides Birdwood's report there is no other evidence to confirm the existence of this species at Mahabaleshwar.

MAGNOLIACEAE

Michelia Linn.

1. **Michelia champaka** Linn., Sp. Pl. 537, 1753; FBI 1: 42; Lisboa: 208; Birdwood: 6; Nairne: 7; Cooke 1: 7(8).

A cultivated ornamental tree.

FLOWERS. May; FRUITS. May-August.

LOCAL NAME. *Champa, Sonchampa.*

ANNONACEAE

Following four species have been reported by Lee and Birdwood but no specimens are avaiable in any herbarium. They have not been seen by any subsequent collectors. These species were in all probability observed at the foot of the hills on the way to Mahabaleshwar, but do not occur on the plateau.

1. **Polyalthia cerasoides** (Roxb.), Benth. et Hook. f., Fl. Brit. India 1: 63-4, 1872; Lee: 19. 1885.
2. **Uvaria narum** Wall. ex W. & A., Prodr. 9, 1834; Birdwood: 6, 1897.
3. **Uvaria lurida** Hook. f. & Thomson, Flora Indica: 101, 1855; Birdwood: 6, 1897.
4. **Sageraea laurifolia** (Grah.) Blatter, in J. Bombay nat. Hist. Soc. 34: 294, 1930.

Guatteria laurifolia Graham, Cat. 4, 1839.
Bocagea dalzellii Hook. f. & Thoms. *in* FBI 1: 92, 1872; Birdwood: 6, 1897.

MENISPERMACEAE

(Key based on male specimens)

1. Stamens connate; anthers in a terminal head or in a ring 2
    2. Flowers stalked, solitary or in umbellate heads .... *Stephania*
    2. Flowers in panicles 3
        3. Calyx campanulate .... *Cyclea*
        3. Calyx of 4 spreading sepals .... *Cissampelos*
1. Stamens free 4
    4. Leaves obtuse or subcordate; panicles ± 30 .... *Tinospora*
    4. Leaves deeply cordate; panicles small...... cm. long .... *Diploclisia*

(Key based on female specimens)

1. Style scar terminal .... *Tinospora*
1. Style scar basal 2
    2. Inflorescence subtended by foliaceous cordate bracts .... *Cissampelos*
    2. Inflorescence not subtended by cordate bracts 3
        3. Ovaries 3-many .... *Diploclisia*
        3. Ovary solitary 4
            4. Flowers in panicles............*Cyclea*
            4. Flowers in umbels..........*Stephania*

Tinospora Miers.

1. **Tinospora sinensis** (Lour.), Merr. in Sunyatsenia 1: 193, 1934.

Tinospora malabarica (Lamk.) Hook. f. & Thoms., Fl. Ind. 183, 1855; Dalz. & Gibs.: 5; FBI 1; Nairne; 10; Woodrow: 121; Cooke 1: 19(19); Talbot 1: 36; Blatter 34: 549; Santapau, 301.

Compylus sinensis Lour., Fl. Cochinch.: 113, 1790.

Menispermum malabaricum Lamk. Encycl. 4: 96, 1797.

Cocculus malabaricus DC. syst. 1: 518. 1818; Graham: 4.

Collected from Fitzgerald Ghat; it is a rare plant. Young stems become terete on drying.

FLOWERS. November; FRUITS. January (Woodrow).

Cissampelos Linn.

1. **Cissampelos pareira** Linn., Sp. Pl.: 1031, 1753; FBI 1: 103; Nairne: 11; Woodrow 11: 121; Cooke 1: 22(24); Blatter 31: 555; Santapau: 4.

This species is known from only one collection from Mahabaleshwar.

FLOWERS. May-September; FRUITS. August-October.

LOCAL NAME. *Pahad vel.*

LOCAL USES. Roots are considered of medicinal value.

Cyclea Arn.

1. **Cyclea peltata** (Lamk.) Hook. f. & Thomson, Fl. Indica; 201, 1855; **FBI** 1: 104; Cooke, T. 1: 24(25); Birdwood: 6; Puri & Mahajan: 119.

Menispermum peltatum Lamk. Encycl. 4: 96, 1797.

Frequently seen along the Fitzgerald Ghat.

FLOWERS. Throughout the year;

FRUITS. March-April.

LOCAL NAME. *Padal.*

Stephania Lour.

1. **Stephania japonica** (Thunb.) Miers, in Ann. nat. Hist. ser. 3, 18: 14, 1866; Blatter 31: 555; Santapau: 4.

S. hernandifolia (Willd.) Walp., Repert. 1: 96, 1842; FBI 1: 103 (p.p.); Cooke, T. 1: 22 (23); Puri & Mahajan: 119; Santapau: 301.

Clypea hernandifolia Wt. & Arn., Prod.: 14, 1834; Wight, Icon. t. 939.

A quite common climber among the bushes mostly in shady places. Tiger's Path, Lingmala, Chinaman's falls, Kate's point, etc.

FLOWERS. July-August; FRUITS. September-December.

LOCAL NAME. *Tanvel.*

Diploclisia Miers

1. **Diploclisia glaucescens** (Blume) Diels, in Engl. Pfreich. 46: 225, t. 77, 1910; Blatter 31: 551; Santapau: 301.

Cocculus glaucescens Blume, Bijdr. 25, 1825.

C. macrocarpus Wt. & Arn., Prod.: 13, 1834; Graham: 5; FBI 1: 101; Cooke 1: 20(22); Birdwood: 6; Puri & Mahajan: 119.

Common in thick forest along Fitzgerald Ghat. Large liane over 30 m in length climbing over tallest trees. The glaucous green colour of the leaves and their distinctive round shape renders the plant quite conspicuous. The large pendulous racemes of mature, white fruits is a unforgettable sight in the month of May.

FLOWERS. February-April; FRUITS. May-August.

LOCAL NAME. *Watoli, Watan vel.*

LOCAL USES. Leaves used as beedi wrappers. Fruits are considered to be poisonous.

NYMPHAEACEAE

Nymphaea Linn. (*Nom. cons.*)

1. **Nymphaea nouchali** Burm. f., Fl. Ind.: 120, 1768; Santapau; 5.

N. pubescens Willd. Sp. Pl. 2: 1154, 1799; Blatter 34: 294.

N. rubra Roxb. *ex* Salisb., Parad. Lond. 1, subt. 14, 1805; Wight, Ills. t. 10; Graham; 5.

N. lotus Hook. f. & Thomson, FBI 1: 114, 1872 (*non* Linn. 1753); Cooke 1: 25 (26).

Some plants of this species are cultivated as ornamental plants in open tanks at Madhu-Kosh and Bhilar Estate. Red, white and blue flowered plants were seen.

PAPAVERACEAE

Argemone Linn.

1. **Argemone mexicana** Linn., Sp. Pl.: 508, 1753; Graham: 6; Dalz. & Gibs.: 6; Cooke: 699 & 1: 27 (29); Birdwood: 6; Puri & Mahajan: 119.

A weed of waste lands and of cultivated fields. This yellow flowered Mexican Poppy dies quickly with the onset of monsoon.

FLOWERS. April-May; FRUITS. April-May.

LOCAL NAME. *Piula Dhotra, Dharuri, Kante Dhotra.*

Brassicaceae

1. Plants glabrous 2

2. Fruits less than 3-times as long as broad, silicula 3

3. Fruits strongly compressed, flat 4

4. Seeds 1-2 per fruit........*Coronopus*

4. Seeds 4-many in each fruit....*Lepidium*

3. Fruits not or scarcely compressed, ovoid, inflated or with crested valve.......... .... *Rorippa*

2. Fruits 4-times or more as long as broad, siliqua 5

5. Fruit biarticulated, beaked or with a short, beak-like stylar apex........... *Brassica*

5. Fruits neither jointed or beaked......6

6. Fruits straight, opening from below upwards; seeds one-seriate........... .... *Cardamine*

6. Fruits ± curved, opening uniformly; seeds ± 2- seriate .... *Nasturtium*

1. Plants pilose or hairy.......................7

7. Hairs simple 8

8. Fruits generally less than 3-times as long as broad 9

9. Fruits compressed .... 10 (if not compressed then winged or didymous)

10. Fruits more or less winged, cultivated plants .... *Iberis*

10. Fruits not winged or slightly winged above; valves keeled .... *Lepidium*

9. Fruit not compressed, neither winged nor didymous .... *Rorippa*

8. Fruits 4-times or more as long as broad 11

11. Leaves simple, entire or dentate .... *Brassica*

11. Leaves pinnatifid or pinnatisect .. 12

12. Fruit dehiscent by valves.....13

13. Petals yellow .. *Sisymbrium*

13. Petals white or pink....... .... *Cardamine*

12. Fruits breaking transversely into segments .... *Raphanus*

7. Hairs branched or stellate, sometimes glandular and intermixed .... *Capsella*

Brassica Linn.

1. Racemes elongated, neither fleshy nor covered with leaves .... *B. oleracea* var. *oleracea*

1. Racemes congested, fleshy and abbreviated, ± covered with leaves .... *B. oleracea* var. *botrytis*

1. **Brassica oleracea** Linn., Sp. Pl.: 667, 1753; var. **capitata** Linn., Sp. Pl.: 667, 1753.

Cultivated vegetable crop grown in gardens.

LOCAL NAME. *Kobichi bhaji.*

2. **Brassica oleracea** Linn. var. **botrytis** Linn., Sp. Pl.: 667, 1753.

This is also a cultivated vegetable crop grown occasionally in farms.

LOCAL NAME. *Phul kobi.*

Capsella Medik

1. **Capsella bursa-pastoris** (Linn.) Medik., Pflanzengatt 1: 85, 1792; Birdwood: 7: Cooke 1: 32 (34); Puri & Mahajan; 119.

Thalaspi bursa-pastoris Linn., Sp. Pl.: 647, 1753.

An introduced weed recorded from cultivated fields.

Cardamine Linn.

1. **Cardamine hirsuta** Linn., Sp. Pl.: 655, 1753.

C. trichocarpa Hochst. *ex* Rich., Tent. Fl. Abys. 1: 18, 1847; Santapau: 7.

C. subumbellata Hook. f. & Thomson, *in* FBI. 1: 138, 1872; Birdwood: 7; Cooke: 649 & 1: 30 (32); Puri & Mahajan: 119.

Common and abundant weed along roadsides and among the cultivated plants.

Coronopus J. G. Zinn

1. **Coronopus didymus** (Linn.) Smith, Fl. Brit. 2: 691, 1804.

Lepidium didymum Linn., Mantissa 1: 92, 1767.

A weed in wastelands in town and near Lodwick point.

Iberis Linn.

1. **Iberis amara** Linn., Sp. Pl.: 649, 1753.

Collected only once at Yenna lakeside.

Lepidium Linn.

1. **Lepidium sativum** Linn., Sp. Pl.: 644, 1753; Cooke, T. 1: 29 (37).

Rarely cultivated in farms at Mahabaleshwar.

LOCAL NAME. *Aliv.*

Nasturtium R.Br.

1. **Nasturtium officinale** R.Br. *in* Aiton, Hort. Kew., ed 2, 4: 110, 1812; Birdwood: 7; Cooke: 649 & 1: 29 (31); Puri & Mahajan: 119.

Sisymbrium nasturtium-aquaticum Linn., Sp. Pl.: 657, 1753.

Rorippa nasturtium-aquaticum (Linn.) Hayek, Sched Fl. Styr. Exs.: 22, 1905.

Lingmala, Mahabaleshwar.

An introduced cultivated plant found growing wild, near water-courses.

CLEOMACEAE

Cleome Linn.

1. **Cleome speciosissima** Lindl., *in* Bot. Reg.: 1312, 1836; Dalz. & Gibs. suppl.: 5; Lisboa: 209.

A native species of Mexico, commonly cultivated in gardens. Often runs wild. Reported by Lisboa.

FLOWERS. April-May.

CAPPARACEAE

Capparis Linn.

1. Flowers in corymbose inflorescence .... *C. rotundifolia*
1. Flowers axillary, solitary or in umbels 2
    2. Spines straight .... *C. divaricata*
    2. Spines hooked 3
        3. Fruits ovoid or oblong ...... *C. spinosa*
        3. Fruits piseiform .... *C. tenera*

1. **Capparis rotundifolia** Rottl. *in* Ges. Naturf. Fr. Nene Schr. 4: 185, 1809.

Capparis longispina Hook. f. & Thomson, *in* Fl. Brit. India 1: 176, 1872; Birdwood: 7; Talbot 1: 60; Blatter, J. Bombay nat. Hist. Soc. 31: 906; Santapau: 291 & 399.

C. pedunculosa var. *longispina* Cooke, Fl. Pres. Bombay 1: 48 (51), 1901.

C. pedunculosa (*non* Dalz. & Gibs. 1961) *sensu;* Birdwood: 7; Puri & Mahajan: 119.

This is one of the commonest straggling spiny bushes at Mahabaleshwar. It resembles *Scutia circumscisa* in appearance, but can be differentiated by its green pendulous fruits on long stalks.

Fitzgerald Ghat, Lodwick point, Dhobi's falls, Tiger path.

FLOWERS. March-May. FRUITS. May-June.

LOCAL NAME. *Kolisna.*

2. **Capparis divaricata** Lam., Encycl. 1: 606, 1785; Wight, Icon. t. 889, 1844; FBI 1: 174; Lisboa: 208; Cooke 1: 45 (48).

Capparis stylosa DC., Prod. 1: 246, 1824; Graham: 8; Dalz. & Gibs.: 10; Blatter 31: 904.

Included on the authority of Lisboa who reports it from the foot of Mahabaleshwar, between Bhima and Krishna rivers.

FLOWERS. April-May.

3. **Capparis spinosa** Linn., Sp. Pl.: 503, 1753; Nairne: 17; Birdwood: 401; Woodrow: 11; Cooke 1: 44 (47); Talbot 1: 53; Blatter 31: 903.

C. spinosa var. *vulgaris* Hook. f. & Thoms. *in* FBI 1: 173, 1872; Birdwood: 7.

C. murrayana Graham, Cat. Bombay Pl.: 9, 1839; Wight, Icon. t. 379; Dalz. & Gibs.: 9.

C. spinosa var. *murrayana* Lisboa *in* J. Roy. Asiat. Soc. Bombay 15: 209, 1883.

A common plant along the banks of the lake and on sides of nullas in stony situations. Sometimes it is seen growing on the walls of the bridges.

Fitzgerald Ghat, Yenna lake.

FLOWERS. December.

4. **Capparis tenera** Dalz. *in* Hook., Kew J. Bot. 2: 41, 1850; Dalz. & Gibs.: 9; Lisboa: 209.

Included on the authority of Lisboa. No spemen available.

Flacourtiaceae

1. **Flacourtia indica** (Burm. f.) Merr., Interpret. Rumph. Herb. Amb.: 377, 1917; Santapau *in* Fl. Khandala: 10.

Gmelina indica Burm. f., Fl. Ind.: 132, t. 39, f. 5, 1768.

F. inermis Graham, Cat. Bombay Pl.: 10, 1839 (*non* Roxb. 1820).

F. ramontchi Lisboa *in* J. Roy. Asiat. Soc. Bombay, 15: 209, 1883.

F. ramontchi L'Her. var. *latifolia* Hook. f. & Thomson, FBI 1: 193, 1872; Talbot 1: 77.

F. latifolia Cooke *in* Fl. Pres. Bombay 1: 56, 1901; Blatter: 913; Santapau: 296; Puri & Mahajan: 119.

This is one of the common forest components of Mahabaleshwar. Fruit is edible when ripe, but very strongly astringent when raw. Trees of this species very often found loaded with Loranthaceous parasites.

LOCAL NAME. *Tambat*.

FLOWERS. January-June; FRUITS. January-October.

Pittosporaceae

1. **Pittosporum floribundum** Wt. & Arn., Prod.: 154, 1834; Graham: 38; FBI 1: 199 (p.p.); Birdwood: 401; Cooke: 647 & 1: 58 (61); Talbot: 81; Puri & Mahajan: 119.

P. nepaulense Blatter, J. Bombay nat. Hist. Soc. 34: 302, 1930.

A rare tree at Mahabaleshwar.

Fitzgerald Ghat, Rotunda Ghat.

LOCAL NAME. *Yekandi*.

Polygalaceae

1. **Polygala persicariaefolia** DC. Prod. 1: 326, 1824; FBI 1: 202; Cooke: 649 & 1: 63 (63); Blatter 34: 302; Chodat, Monogr. Polygal, pt. 2, 331, t. 27, ff. 22-23, 1914; Birdwood: 7; Puri & Mahajan: 119.

Common monsoon species in grassy patches at the edges of the forests. Rare at Mahabaleshwar.

Lingmala.

FLOWERS. October-November.

Caryophyllaceae

1. Stipules scarious .... *Polycarpon*
1. Stipules 0 2
    2. Calyx gamosepalous; petals long clawed .... *Vaccaria*
    2. Calyx polysepalous, petals subsessile, not clawed or altogether absent .... *Stellaria*

Stellaria Linn.

1. **Stellaria media** (Linn.) Vill. Hist. Pl. Danph. 3: 615, 1789; FBI 1: 230; Birdwood: 7; Woodrow: 11; Cooke 1: 64 (68); Blatter; 304; Puri & Mahajan: 120.

Alsine media Linn., Sp. Pl.: 272, 1753.

Common chick-weed. Weed of cultivation and wastelands.

FLOWERS & FRUITS. December.

Polycarpon Linn.

1. **Polycarpon prostratum** (Forsk.) Aschers. *et* Schweinf. *in* Oster. Bot. Zeit. 39: 128, 1889; Santapau: 12.

Alsine prostrata Forsk., Fl. Aeg.-Arab.: 207, 1775.

P. indicum (Retz.) Merrill *in* Phil. J. Sci. Bot. 10: 302, 1905; Blatter 34: 304.

P. loeflingiae Benth. & Hook. f., Gen. Pl. 1: 153, 1862; Cooke 1: 65 (69); Birdwood: 7; Puri & Mahajan: 120.

A prostrate herb of wet places. When dry whole plant turns deep brick-red.

Yenna lake, Lingmala, Dhobi's falls, Bus stand, etc.

FLOWERS. April-May; FRUITS. June.

Vaccaria

1. **Vaccaria pyramidata** Medik., Phil. Bot. 1: 96, 1789; Santapau: 12.

Saponaria vaccaria Linn., Sp. Pl.: 409, 1753; FBI 1: 217; Nairne: 22; Woodrow: 124; Cooke 1: 66 (66).

Soapwort. Often cultivated in gardens. Established locally as an escape from gardens.

LOCAL NAME. *Sabni*.

FLOWERS. February-April; FRUITS. April-May.

Dianthus Linn.

1. **Dianthus caryophyllus** Linn. Sp. Pl.: 410, 1753; Blatter: 304.

Cultivated in gardens.

LOCAL NAME. Pink carnation.

FLOWERS. May-June.

PORTULACACEAE

1. **Portulaca oleracea** Linn., Sp. Pl.: 445, 1753; FBI 1: 246; Birdwood: 401; Cooke 1: 72 (72) & 469; Puri & Mahajan: 120.

The common Purslane. A prostrate succulent herb in yellow flowers. Rare in Mahabaleshwar, in wastelands and fallow fields.

FLOWERS & FRUITS. Dry seasons.

CLUSIACEAE

1. Calyx of 4 or 5 sepals .... *Garcinia*
1. Calyx bursting open in two valves .... *Mammea*

Garcinia Linn.

1. **Garcinia indica** (Du Petit-Thou.) Choiss. *in* DC., Prodr. 1: 561, 1823; Birdwood: 7.

Brindonia indica Du Petit-Thouars *in* Dict. Sc. Nat. 5: 339, 1804.

This species included here on the authority of Birdwood.

Mammea Linn.

1. **Mammea suriga** (Buch.-Ham.) Birdwood, Cat. Fl. Matheran & Mahableshwar: 7, 1897; Kosterm. *in* Comm. For. Res. Inst. Indonesia, Bogor 72: 23, f. 19, 1961; Santapau: 15.

Calophyllum suriga Buch.-Ham. *ex* Roxb. Fl. Ind. 2: 608, 1832; FBI 1: 276, 1874.

Calysaccion longifolium Wight, Ill. 1: 130, 1840 and Icon. t. 1999.

Included on the authority of Birdwood only. No specimen available.

TERNSTROEMIACEAE

Camellia Linn.

1. **Camellia sinensis** O. Kuntze, Erde; 500, 1881.

Thea sinensis Linn., Sp. Pl.: 515, 1753; *C. thea*. Link., Enum. Hort. Berol. 2: 73, 1833; Lisboa 15: 209.

The Tea plant was introduced for cultivation at Mahabaleshwar about the middle of last century, but the project did not prove commercially sound. There are still some bushes growing on the slopes near Bhilar, about 10 km away from Mahabaleshwar on way to Panchgani.

FLOWERS & FRUITS. December.

LOCAL NAME: *Chaha*.

MALVACEAE

1. Erect trees; flowers with accrescent involucre. .... *Kydia*
1. Shrubs, undershrubs or herbs................2
   2. Involucral bracts absent..................3
      3. Flowers ± 5 cm in diameter, showy; leaves cordate .... *Abutilon*
      3. Flowers ± 2.5 cm in diameter; leaves not cordate .... *Sida*
   2. Involucral bracts present 4
      4. Calyx spathaceous, deciduous .... *Abelmoschus*
      4. Calyx not spathaceous, persistent........ .... *Hibiscus*

Kydia Rosch.

1. **Kydia calycina** Roxb., Pl. Cor. 3: 12, t. 215, 1819; Graham: 20; FBI 1: 348, Birdwood; 8: Cooke 1: 94 (100); Talbot 1: 127, t. 78; Blatter 34: 629; Santapau: 16.

This is a very rare tree on Mahabaleshwar plateau. However it is very common at lower elevations. Often cultivated along roadsides.

Koyna valley.

FLOWERS & FRUITS. August-December.

Abutilon Linn.

1. **Abutilon persicum** (Burm. f.) Merrill, Philipp. J. Sci. 19: 364, 1921.

Sida persica Burm. f., Fl. Ind.: 148, t. 47, f. 1, 1768.

A. polyandrum (Roxb.) Wt. & Arn., Prod.: 55, 1834; Graham, 15; FBI 1: 325; Nairne: 28; Birdwood: 8; Cooke 1: 95 (101); Blatter 34: 629; Santapau: 17.

Sida polyandra Roxb., Fl. Ind. 3: 173, 1832.

A common shrub or undershrub found on grassy slopes, very conspicuous by its very prominent yellow or pale orange flowers. Often associated with *Carvia callosa* at the edges of the forests.

Chinaman's falls, Fitzgerald Ghat.

LOCAL NAME. *Madan.*

FLOWERS & FRUITS. November-January.

Sida Linn.

1. Cocci aristate .... *S. spinosa*
1. Cocci acute, not aristate 2
    2. Pedicels jointed below middle .... *S. orientalis*
    2. Pedicels jointed above middle............3
        3. Pedicels longer than leaves............ .... *S. cordata*
        3. Pedicels shorter than leaves......*S. acuta*

1. **Sida acuta** Burm. f., Fl. Ind.: 147, 1768; Cooke 1: 93 (98); Blatter 34: 628; Puri & Mahajan: 120; Santapau: 15.

S. carpinifolia Linn. f. suppl.: 126, 1781; FBI 1: 323; Birdwood: 8; Cooke: 648.

There is only one specimen of this species from Mahabaleshwar. This specimen is slightly hairy on the under surface of lamina.

2. **Sida rhombifolia** Linn. Sp. Pl.: 684, 1753.

Sida orientalis Cav., Diss. 1: 21, t. 12, f. 1, 1791.

S. rhombifolia var. *rhomboidea* Masters *in* Fl. Brit. Ind. 1: 324, 1874; Santapau: 16.

S. rhombifolia forma *rhomboidea* Blatter. J. Bombay nat. Hist. Soc. 34: 629, 1930.

Occasionally found in open situations on loose, red soil. Tap root is very long.

Lodwick point. Chinaman's falls.

FLOWERS & FRUITS. September-January.

3. **Sida spinosa** Linn., Sp. Pl.: 683, 1753; Lisboa; 209; Cooke 1: 92 (98); Blatter 34: 628.

S. alba Linn., Sp. Pl., ed. 2: 960, 1763; Dalz. & Gibs.: 17.

Included here on the authority of Lisboa.

4. **Sida cordata** (Burm. f.) Borssum, Blumea 14: 182, 1966.

Melochia cordata Burm. f., Fl. Ind.: 143, 1768.

S. veronicifolia Lam., Encycl. 1: 5, 1763; Puri & Mahajan: 120.

Included on the authority of Puri and Mahajan.

Hibiscus Linn.

1. **Hibiscus rosa-sinensis** Linn., Sp. Pl.: 694, 1753; Graham: 13; Dalz. & Gibs. Suppl.: 6; Cooke 1: 113 (120); Blatter 34: 634; Santapau: 18; Puri & Mahajan: 120.

Cultivated shrub which is grown for its ornamental flowers, used for decoration as well as for worship.

LOCAL NAME. *Jasvant.*

FLOWERS. Throughout the year.

2. **Hibiscus hirtus** Linn., Sp. Pl.: 694, 1753; Cooke, 1: 106 (113).

A rare plant at Mahabaleshwar only known from one collection by Rev. R. D. Acland from Chakdeo.

Abelmoschus Medik.

1. **Abelmoschus manihot** (Linn.) Medik. Malv. Fam. 46, 1787; Santapau: 18.

Hibiscus manihot Linn. Sp. Pl. 696, 1753.

A. tetraphyllus Graham, Cat.: 14, 1839.

H. tetraphyllus Roxb., Fl. Ind. 3: 211, 1832; FBI., 1: 341; Cooke 1: 111 (118); Talbot 1: 123, t. 74.

Occasional but conspicuous species due to its large yellow flowers found on the grassy hill-slopes, during monsoon as well as post-monsoon periods.

LOCAL NAME. *Ran bhendi.*

FLOWERS & FRUITS: September-November.

Malva Linn.

1. **Malva sylvestris** Sp. Pl.: 689, 1753.

Malva mauritiana Linn. Sp. Pl.: 689, 1753.

A cultivated ornamental plant occasionally seen in gardens.

Azanza Alef.

1. **Azanza lampas** (Cav.) Alef. in Bot. Zait. 19: 298, 1861; Santapau: 19.

Hibiscus lampas Cav. Diss. 3: 154, t. 56, f. 2, 1787; Graham: 13; Wight. Icon. t. 5.

Thespesia lampas (Cav.) Dalz. & Gibs. Bombay Fl.: 19, 1861; FBI 1: 345, Talbot 1: 124, t. 75; Nairne 32.

T. macrophylla Blume, Bijdr. 73, 1825; Cooke. 1: 114(121).

A common monsoon shrub on sloping grounds among the grasses. The bark of this plant used by natives for cordage.

LOCAL NAME: *Ran bhendi.*

FLOWERS & FRUITS: September-November.

BOMBACACEAE

1. **Salmalia malabarica** (DC.) Schott & Endlicher, Melet. Bot. 35, 1832; Saldanha & Nicolson, Fl., Hassan Dist.: 145, 1976.

Bombax malabaricum DC. Prodr. 1: 479, 1824; Beddome, Fl. Sylv. t. 82, 1871; Birdwood: 8; Cooke. 1: 120 (127).

There is one tree of this species near 56th milestone on Kelghar Ghat on Satara Road.

LOCAL NAME: *Semul, Savar.*

STERCULIACEAE

1. Flowers unisexual, petals 0............*Sterculia*
1. Flowers hermophrodite, petals present........2
   2. Fruits spirally twisted; seeds not winged.... .... *Helicteres*
   2. Fruits not spirally twisted; seeds winged .... *Pterospermum*

Sterculia Linn.

1. **Sterculia foetida** Linn. Sp. Pl.: 1008, 1753; Graham: 18; Dalz. & Gibs. suppl. 10; Wight, Icon. t. 181; FBI 1; 354; Cooke 1: 130 (130); Blatter 34: 878.

A tall tree, shady in hot season. Flowers with strong and disagreeable odour. Only seen in cultivation near Bhilar. Seeds are eaten locally.

LOCAL NAME: *Jungli badam.*

FLOWERS & FRUITS: March-May.

Helicteres Linn.

1. **Helicteres isora** Linn. Sp. Pl.: 963, 1753; Graham: 16; Dalz. & Gibs. 22: Wight, Icon. t. 180; Nairne: 35; Birdwood: 403; Woodrow 12: 129; Cooke 1: 138 (136); Talbot 1: 146, t. 89; Blatter 34: 897; Santapau: 22.

A shrub with bright red flowers and twisted fruits. Colour of the flowers gradually changes to pale lead colour. Common in undergrowth on Fitzgerald Ghat and in the Koyna Valley.

LOCAL NAME: *Murad sheng.*

FLOWERS: July-Septmber; FRUITS: December-March.

LOCAL USE: Used in children's medicine.

Pterospermum Schreb.

1. **Pterospermum acerifolium** Willd. Sp. Pl. 3: 729, 1800; Graham: 20; FBI 1: 368; Cooke 1: 137 (137); Talbot 1: 149; Blatter 34: 880.

Found in gardens in cultivation.

LOCAL NAME: *Kanak champa.*

Eriolaena DC.

1. **Eriolaena candollei** Wall. Pl. Asiat. Rare. 1: 51, t. 64, 1830; Dalz. & Gibs. 24: FBI 1: 370; Cooke 1: 131 (140); Talbot 1: 151, tt. 92-93; Lisboa: 209.

Included on the authority of J. C. Lisboa.

LOCAL NAME: *Bothi.*

FLOWERS: April-May.

ELAEOCARPACEAE

1. Drupe 5-celled .... *E. sphaericus*
1. Drupe 1-3 celled 2
    2. Drupe oblong, falcate .... *E. serratus*
    2. Drupe ovoid, straight .... *E. tectorius*

1. **Elaeocarpus serratus** Linn., Sp. Pl.: 515, 1753; Puri & Mahajan: 120.

Puri and Mahajan reported this species from Lingmala.

2. **Elaeocarpus sphaericus** (Gaertn.) Schum., *in* Engl. & Prantl. Pfam. 3(6): 5, 1895; Santapau: 27.

Ganitrus sphaerica Gaertn., Fruct 2: 271, t. 139, 1701; Wight, Icon. t. 66, 1838.

E. ganitrus Roxb., Fl. Ind. 1: 400, 1832; Graham: 22; Dalz. & Gibs.: 27; FBI I: 400; Cooke 1: 151 (160); Talbot 1: 170, t. 105; Lisboa; 209.

Included on the authority of Lisboa.

FLOWERS: Cold season (Lisboa).

3. **Elaeocarpus tectorius** (Lour.) Poiret in Lam. Encycl. suppl. 2: 704, 1812; Saldanha, Fl. Hassan: 131.

Craspedum tectorium Lour., Fl. Cochinch. 336, 1790.

E. oblongus auct. (non Gaertn. 1788), Graham, Cat. Bombay: 21, 1839; Dalz. & Gibs.: 27; FBI 1: 403; Cooke 1: 138 (161); Talbot 1: 146, t. 89; Birdwood: 9; Puri & Mahajan: 120.

There are a few trees of this species on Lingmala plateau and near Yenna Lake. It is a very beautiful tree when in flowers.

LOCAL NAMES: *Kasau, Kas, Kasso, Kasu.*

FLOWERS: March-June; FRUITS: March-November.

TILIACEAE

1. Fruit unarmed 2
    2. Inflorescence terminal; mesocarp of the fruit fibrous .... *Microcos*
    2. Inflorescence axillary or extra-axillary; mesocarp not fibrous .... *Grewia*
1. Fruits prickly 3
    3. Trees; fruits over 3 cm long.... *Erinocarpus*
    3. Herbs or undershrubs; fruits less than 1 cm long .... *Triumfetta*

Microcos Linn.

1. **Microcos paniculata** Linn., Sp. Pl.: 514, 1753; Santapau, Fl. Saurashtra 1: 70.

Grewia microcos Linn., Syst. (ed. 12): 602, 1767; Graham: 21; Dalz. & Gibs.: 26, Nairne: 38; Birdwood: 403 & 9; Woodrow 12: 130; Cooke 1: 145 (154); Talbot 1: 168; Blatter 34: 890; Pierre, Pl. Cochinch. t. 152; Puri & Mahajan; 120; Santapau; 309.

Common tree on Fitzgerald Ghat, in Koyna Valley and Savitri Valley. The terminal inflorescence and fibrous mesocarp of the fruit are distinctive features of this species.

LOCAL NAME: *Shiral.*

FLOWERS: May-October; FRUITS: December.

Grewia Linn.

1. Leaves glabrous 2
    2. Fruits 4-lobed .... *G. orientalis*
    2. Fruits 2-lobed .... *G. glabra*
1. Leaves tomentose 3
    3. Leaves ovate .... *G. tilaefolia*
    3. Leaves linear-oblong 4

4. Leaves 4-5 ribbed; flowers white .... *G. hirsuta*
4. Leaves 3-ribbed; flowers yellow..................................... *G. pilosa*

1. **Grewia tiliaefolia** Vahl, Symb. Bot. 1: 35, 1790; Graham: 21; Dalz. & Gibs.: 26; FBI 1: 386; Birdwood; 9 & 403; Woodrow; 11; 130; Cooke 1: 141 (150); Talbot 1: 160; Blatter 34: 887.

G. arborea Roxb. *ex* Roth. in *in* Neve Schr. Ges. Nat. Freund. 4: 205, 1803.

Included on the authority of T. Cooke, who reports it from Koyna Valley.

LOCAL NAME: *Dhaman.*

FLOWERS & FRUITS: March-August.

2. **Grewia orientalis** Linn., Sp. Pl.: 964, 1753; Blatter 34: 886.

G. columnaris Sm. *in* Rees, Cyclop.: 17: no. 5, 1811; Graham: 21; Dalz. & Gibs.: 26; FBI 1: 383; Nairne: 38; Woodrow 12: 130; Cooke 1: 138 (147); Talbot 1: 157.

Included on the authority of Nairne.

3. **Grewia glabra** Blume, Bijdr.: 115, 1825.

G. disperma Rottb. *ex* Spreng., Syst. 2: 579, 1825; Santapau: 24.

G. laevigata auct. (non Vahl, 1790) Fl. Br. India 1: 389, 1874; Woodrow 12: 130; Cooke 1: 143 (152); Talbot 1: 164, t. 101; Blatter 34: 888.

A small tree along Fitzgerald Ghat with creamy white flowers.

LOCAL NAME: *Kaori.*

FLOWERS: August-December;

FRUITS: October-February.

4. **Grewia hirsuta** Vahl, Symb. Bot. 1: 34, 1790; Graham; 21; FBI 1: 391; Nairne; 38; Woodrow: 130; Cooke 1: 144 (153); Talbot 1: 166; Blatter 34: 889.

Reported here on the authority of Nairne.

FLOWERS: August-September;

FRUITS: November-January.

5. **Grewia pilosa** Lamk., Encycl. 3: 43, 1789; Dalz. & Gibs.: 26; FBI. 1: 388; Nairne: 38; Birdwood: 403; Woodrow 12: 130; Cooke 1: 143 (151).

G. flavescens Juss. in Ann. Mus. 4: 91, 1804; Blatter 34: 888.

G. carpinifolia Masters, *in* Flora Brit. India 1: 387, 1874.

Included here on the authority of Birdwood.

LOCAL NAME: *Khatkhati.*

FLOWERS: August-October.

Erinocarpus Nimmo

1. **Erinocarpus nimmonii** Graham, Cat. Bombay Pl.: 21, 1839; Dalz. & Gibs.: 27; Birdwood: 403; Woodrow 12: 265; Talbot 1: 168, t. 104-105; Blatter 34: 889; Santapau: 25; Puri & Mahajan: 120.

E. nimmonianus Mast. in FBI 1: 394, 1874; Nairne: 38.

This species is found in Koyna Valley below Mahabaleshwar plateau.

LOCAL NAMES: *Bher, Chaora.*

FLOWERS: August-September;

FRUITS: October-July.

Triumfetta Linn.

1. Bristles of fruit ± 10 mm. ....*T. pilosa*
1. Bristles of fruit ± 5 mm. ......*T. rhomboidea*

1. **Triumfetta pilosa** Roth,, Nov. Pl. Sp.: 223, 1821; Dalz. & Gibs.: 25: FBI 1: 394; Nairne: 38; Birdwood: 9 & 403; Woodrow 11: 265; Cooke 1: 174 (156); Santapau: 30.

T. cana Blume, Bijdr.: 113, 1825; FBI 1: 396.

T. tomentosa Noronha ex Blatter. J. Bombay nat. Hist. Soc. 34: 890, 1931.

This is a rare species and has been collected only from Lingmala.

LOCAL NAMES: *Nichurdi, Kutree-Wandree.*

FLOWERS: November-December;

FRUITS: February-March.

2. **Triumfetta rhomboidea** Jacq., Enum. Pl. Carib.: 22, 1760; FBI 1: 395; Nairne: 38: Birdwood: 403; Woodrow 11: 262; Cooke 1: 147 (156).

T. bartramia Linn., Syst. (ed. 10): 1044, 1759 (nom. illeg.); Blatter 34: 890; Santapau: 30.
T. angulata Lam., Encycl. 3: 421, 1789; Graham: 21; Dalz. & Gibs.: 25.

Fairly common and abundant weed, often gregarious on the outskirts of the forests, in open situations. The plant appears in second half of the monsoon.

LOCAL NAME: *Nichurdi.*

FLOWERS & FRUITS: October-December.

LINACEAE

1. Annual herbs .... *Linum*
1. Shrubs .... *Reinwardtia*

Linum Linn.

1. **Linum mysurense** Heyne ex Benth. apud Lindl. *in* Bot. Reg. 16: sub tab. 1326, 1830; Graham: 33; Dalz. & Gibs.: 16; FBI 1: 411; Nairne: 40; Birdwood 9 & 11: 265; Cooke: 649 & 1: 155 (164); Blatter 34: 892; Santapau: 401; Puri & Mahajan: 120.

A variable annual 3-30 cm tall, found on grassy hill-slopes. Fairly common all over.

LOCAL NAMES: *Undri, Bhamburti.*

FLOWERS & FRUITS: September-December.

Reinwardtia Dumort.

1. **Reinwardtia indica** Dumortier, Comm. Bot.: 19, 1822.

R. trigyna (Roxb.) Planch. *in* Hook. London J. Bot. 7: 522, 1848; Dalz. & Gibs.: 16; FBI 1: 412; Nairne: 40; Birdwood 9 & 403; Woodrow 11: 265; Cooke 1: 155 (165); Blatter 34: 89; Santapau: 299; Puri & Mahajan: 120.
Linum trigonum Roxb. Asiat. Res. 6: 357. 1799 (non Linn. 1753); Graham: 34.

This species has been collected from Lingmala, Fitzgerald Ghat, Chinaman's falls and Koyna Valley. Sometimes it is found in cultivation also.

FLOWERS: August-January; FRUITS: October-January.

MALPIGHIACEAE

Hiptage Gaertn.

1. **Hiptage benghalensis** (Linn.) Kurz, in J. Asiat. Soc. Bengal, 43(2): 136, 1874; Blatter 34: 893; Santapau: 34.

Benistera benghalensis Linn., Sp. Pl.: 437, 1753.
H. medablota Gaertn., Fruct. 2: 169, t. 116, 1791; Graham: 28; FBI 1: 418; Birdwood: 404; Woodrow 11: 265; Cooke 1: 157 (167): Talbot 1: 178, t. 110.

This species seen occasionally along the Fitzgerald Ghat only.

LOCAL NAME: *Madhavi vel.*

FLOWERS: January-March. FRUITS: March-May.

OXALIDACEAE

1. Plants not bulbiferous; flowers yellow........2
    2. Plants not hirsute............*O. corniculata*
    2. Plants hirsute................*O. corniculata* var. *hispida*
1. Plants bulbiferous; flowers violet or pinkish-white 3
    3. Bulbs fibrous; flowers violet.....*O. latifolia*
    3. Bulbs not fibrous; flowers pinkish-white.... .... *O. rubra*

1. **Oxalis corniculata** Linn., Sp. Pl.: 435, 1753; Graham 35; Dalz. & Gibs.: 42; Lisboa: 210; Wight, Icon. t. 18; Nairne: 43; Birdwood 9 & 404; Woodrow 11: 266; Cooke: 650 & 1: 167 (177); Blatter 34: 898.

A quite frequent weed on moist ground in semi-shaded places. Collected from Lodwick Point & Kelghar Ghat.

LOCAL NAMES: *Ambuti, Amrul.*

FLOWERS & FRUITS: January-August.

2. **Oxalis corniculata** var. **hispida** Blatter in J. Bombay nat. Hist. Soc. 34(4): 898, 1931.

Only distinguishing character of this variety from the type variety is that the whole plant is villous.

3. **Oxalis latifolia** H.B.K., Nov. Gen. Sp. 5: 184, t. 567, 1821; Blatter 34: 898; Santapau: 35.

This Mexican species is found naturalized as a common weed of the cultivated fields.

FLOWERS & FRUITS: October-December.

4. **Oxalis rubra** St. Hill, Fl. Bras. 1: 124; 1824; Bailey, 601, 1949.

This species is very often found in cultivation for its showy flowers, but wherever it grows in open fields it spreads very fast and becomes a troublesome weed. Quite frequently it is seen along roadsides.

FLOWERS: December-January.

5. **Oxalis martiana** Zucc. in Densksehr. Acad. Muench. 9: 144, 1823-4 (1824); Puri & Mahajan: 120.

O. corymbossa DC. Prodr. 1: 696, 1824.

A rare species, only known from a single collection. (BSI).

(*To be continued*)

FURTHER OBSERVATIONS ON THE FIELD ECOLOGY OF RAJASTHAN BATS[1]

Y. P. SINHA[2]

Although some information on general activities, sex ratio, food, reproduction, fat deposition, winter lethargy etc. of some bats from Rajasthan and neighbouring areas are provided by Brosset (1962 a, b, c,), Prakash (1963), Khajuria (1965, 1971, 1975), Agrawal (1967), Sinha (1976 a, b; 1977) and Sinha and Advani (1976), nevertheless there is a big lacuna in our knowledge of ecology of bats from these areas.

During 1972-1976, I made extensive field surveys in Rajasthan and ecological data so obtained for 15 species have been checked with previous data and new findings are presented below for each species.

Family PTEROPODIDAE

Rousettus leschenaulti leschenaulti (Desmarest)

The Fulvous fruit bat was obtained from dark, deserted rooms of an old monument at Gagaron-ka-kila (10 km. east of Jhalawar, Rajasthan) in a forested area. The size of colony in the Gagaron-ka-kila was about 1,000 exs. It was noticed in association with *Rhinopoma microphyllum kinneari* in Jhalawar (Rajasthan).

It was seen in the vicinity of bushes laden with ripe fruit at Jhalawar late in the night and was captured in mist-net between mid night and 4 A.M. Many seeds of fruits were seen on the ground at its roosting place. Gut contents showed only brown thick liquid like substances from which it can be concluded that this bat takes only soft parts of fruits.

Several ectoparasites, ticks, mites and wingless fly (Nycteribidae, Diptera) were obtained from the body.

Pteropus giganteus giganteus (Brünnich)

This large fruit bat was not seen in the extreme arid part of Rajasthan due to nonavailability of large trees and scarcity of water but is known to occur at Jodhpur (Prakash 1963) in a garden on *Ficus* tree near a big tank. It is common in humid parts of Rajasthan where large trees are available. Colonies (size 100-1,000 exs.) on banyan (*Ficus bengalensis*), peepal (*Ficus religiosa*), tamarind (*Tamarindus indica*), neem (*Azadirachata indica*) and mango (*Mangifera indica*) were observed in various localities (*viz.* Pali, Jhunjhunu, Dungarpur, Bundi, Ajmer, Banswara and Jhalawar) in semiarid and humid parts of Rajasthan. Further this bat was found always near or in towns and villages near human habitation. It was not found in deep forest nor in temples or old buildings as mentioned by Sanderson (1969) for some other species of *Pteropus.*

Some ectoparasites, wingless fly (Nycteribiidae, Diptera), ticks and mites were obtained.

Cynopterus sphinx sphinx (Vahl)

The short-nosed fruit bat was found active

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in Banswara and Bundi (Rajasthan) immediately after dusk on guava trees in a garden.

Gut contents had only remains of unidentified material.

Some wingless flies (Nycteribiidae, Diptera) were obtained from this bat.

Family RHINOPOMATIDAE

Rhinopoma microphyllum kinneari Wroughton

Besides the desert (Prakash 1963), this bat was obtained from various localities (Sinha 1980) in semiarid and humid parts of Rajasthan. The colony (size varying from 25-500 exs.) was found in somewhat dark and uninhabited houses, temples, caverns and under ground man made tunnels.

Besides previous records (Prakash 1963) this bat was also found in association with *Hipposideros fulvus pallidus* (in Mandore tunnel, and Bhim Bharak cave near Jodhpur and in Jhalara-Patan fort near Jhalawar) and with *Rousettus l. leschenaulti* (in Gagaron-ka-kila near Jhalawar) in Rajasthan. It was also observed in pure colonies in various localities in Rajasthan (namely Malarna Dungar, Sawai Madhopur Dist.; Maroth village, Nagaur Dist.; and Ransi village, Jodhpur Dist.). It seems that this bat is often captured by birds and mammals as it was seen in the beak of a kite and a crow in Maroth village (Nagaur Dist.) and being carried by a cat in Malarna Dungar (Sawai Madhopur Dist.).

Several ectoparasites, e.g., wingless fly (Nycteribiidae, Diptera), bugs (Cimicidae), ticks and mites were collected from this bat.

Large quantities of the guano of this bat is collected by the local people every year and used as fertiliser. According to local people the guano is a good fertiliser especially for chilli and onion.

Rhinopoma hardwickei hardwickei Gray

Prakash (1963) collected this bat from dark portions of ruins and the man-made caverns in arid parts of Rajasthan. Further it was collected from dark portions of deserted houses, temples, caves and tunnels in various places in semiarid and humid parts of Rajasthan by me (Sinha 1980). In comparison with *R. miccrophyllum kinneari* colonies of this bat were smaller, not exceeding 50.

Besides association with *Rhinolophus l. lepidus* (mentioned by Prakash 1963) it was observed with *R. microphyllum kinneari, Hipposideros fulvus pallidus* and *Taphozous k. kachhensis* in Bhim Bharak cave (Jodhpur), with *Taphozous p. perforatus* in a ruined house at Dungarpur, with *Pipistrellus mimus* in a temple at Salawas and with *R. m. kinneari* in Surpura (both in Jodhpur Dist.), Jhalawar and Bundi.

Fat deposition appears to coincide with breeding and winter conditions (Sinha 1976b).

Some information on food and reproduction of this species collected from Rajasthan have already been reported by Sinha and Advani (1976).

Ticks and dipteran fly (Nycteribiidae) were obtained from the body.

Family EMBALLONURIDAE

Taphozous perforatus perforatus Geoffroy

Previously this bat was known only from arid parts of Rajasthan (Prakash 1963). I observed this bat in both arid and humid parts in deserted houses (Luni and Dungarpur) and under ground tunnel (Mandore). It is found in association with *Rhinopoma microphyllum kinneari* (Prakash 1963). The size of colony was small (1-5 exs.) in Rajasthan. This bat was seen to be very active in roosting place even in day time and hence difficult to catch.

Winged dipteran fly (Streblidae) was obtained from its body.

Taphozous longimanus longimanus Hardwicke

The haunt of this bat is quite different from other species. Sinha (1976a) found it in hollows and crevices of peepal and banyan trees in Rajasthan. Brosset (1962a) describes similar habitat in Anand. The size of colony varies from 6-40 exs. It was as active during day time as *T. perforatus* and therefore very difficult to catch. It was never met in association with other bats. Brosset (1962a) also mentions that it does not tolerate other species.

Observations on food and reproduction are recorded by Sinha and Advani (1976).

Ticks, mites and bugs (Cimicidae) were found on this bat.

Taphozous kachhensis kachhensis Dobson

Like *Rhinopoma microphyllum kinneari*, this bat is common in Rajasthan. Prakash (1963) collected it only from Jodhpur. The present observation is based on the collections made from different localities by me (Sinha 1980) in arid as well as humid parts of Rajasthan. Its favourite habitats are cracks, crevices and holes in caves, old houses etc. Its colonies are usually small (4 to 5 exs.) but there are several such colonies in the same building.

Brosset (1962a) and Prakash (1963) have not mentioned its association with other bats. I observed this species in association with *Rhinopoma m. kinneari* and *Hipposideros fulvus pallidus* in Mandore tunnel, Bhim Bharak cave and Jhalara-Patan fort in Rajasthan.

Sinha and Advani (1976) found one female in advanced stage of pregnancy in the last week of September. A female obtained in the last week of July (24.vii.1976, Bhim Bharak cave, Jodhpur) had a suckling young (forearm 53% of the mother; gular sac and pectoral pore well developed; body naked; head well furred; and eye open) in her arm. The female had the right horn of the uterus well swollen (width 5 mm) while the left horn had regressed (width 2 mm). A female collected in the last week of August (Jodhpur, 29.viii.1976) had early pregnancy. Brosset (1962 a) found pregnant females in June at Ahmedabad and towards end of August in Maharashtra. The present observation thus shows that this bat evidently breeds at least twice a year once in July-August and again in October. The female carrying a suckling young which had the right horn of the uterus swollen was obviously a case of post partum pregnancy as mentioned by Gopalakrishna (1955) in *Taphozous longimanus*.

Bugs (Cimicidae) and mites were found as ectoparasites.

Family Megadermatidae

Megaderma lyra lyra Geoffroy

Previously this bat was obtained by Prakash (1963) only from the Mandore nulla and Jodhpur fort (Jodhpur Dist.). It was observed and collected from a tunnel in the old mine (Nangal village, Jhunjhunu Dist.), a dark room in the Ranthambhore fort (Sawai Madhopur Dist.) and Dara fort (Kota Dist.), dungeon (Banswara, Banswara Dist.) and Jhalara Patan fort (Jhalawar Dist.). The colony size varies from 5-100 exs.

When approached the bat sometimes flies towards the intruder. It often flies low, sometimes touching the ground.

In Nangal (Jhunjhunu Dist., Rajasthan) it was found in association with *Rhinopoma m. kinneari* and *R. h. hardwickei*. Sexes may occur mixed or separately, and no regular sexual segregation was noted.

It harbours the winged fly (Streblidae, Diptera).

Family RHINOLOPHIDAE

Rhinolophus lepidus lepidus Blyth

Prakash (1963) observed this bat in small numbers in a pit under the ceiling of a cavern at Bikaner and in a well at Pilani in arid part of Rajasthan. It was observed by me hanging from ceiling of dark temples in forested area (Sikar Burz, Bundi Dist. and Ranthambhore, Sawai Madhopur Dist.). When approached it did not fly out of the room but flew very fast inside the room as earlier reported by Prakash (1963). Only solitary bats were seen and no colony was found. It has not been observed in association with other bats either.

Hipposideros fulvus pallidus Andersen

Inhabits dark, abandoned rooms and tunnels around Jodhpur (a basement in a crowded suburb; a ruined building in a sparsely forested area; a rocky tunnel); also in an abandoned fort (Jhalara Patna).

It is very active in day time, and flies away on human approach. The flight is slow, low and fluttering.

It lives in small colonies not exceeding 25 exs. (generally 4-6), in which both sexes are found.

At Jhalawar it was found in association with *Megaderma l. lyra, Rhinopoma microphyllum kinneari* and *R. h. hardwickei* and in Jodhpur only with *R. h. hardwickei*.

Sinha and Advani (1976) have given some information on food of this bat in Rajasthan.

In July, at Jodhpur, a pair of infants were found, suggesting breeding in June. This is the sole information on breeding. [Brosset (1962b) who combined this species with *H. bicolor* recorded breeding of this 'complex' in April in Maharashtra].

Family MOLOSSIDAE

Tadarida aegyptiaca thomasi Wroughton

It was obtained from dark crevices and cracks in ceilings and walls and from narrow space between wall and notice board from various places in Rajasthan, *viz*. Rajgadh fort (Ajmer Dist.) Kishorepura temple, Kota (Kota Dist.), Dungarpur Middle School (Dungarpur Dist.), ruined houses in Bundi (Bundi Dist.) and Jodhpur court (Jodhpur Dist.). The size of colonies varies from 5-20 exs., sometimes solitary individuals are also found.

Sinha and Advani (1976) have given some information on food and reproduction of this bat. Further, pregnant females collected in August in Jodhpur also support the birth of young in September as indicated by Sinha and Advani (loc. cit.) and Brosset (1962c).

Bugs (Cimicidae), ticks and mites were found as ectoparasites.

Pipistrellus mimus mimus Wroughton

This bat was obtained from cracks, crevices and holes in walls and ceilings of temple and houses in Jodhpur and Salawas (Jodhpur Dist.). The colony size varies from 12-50 exs.; a solitary bat was found hiding in a crack in an old house in Tonk (Tonk Dist.).

At Jodhpur, it starts flying in the evening about 20 minutes after sunset, and returns in the morning 15-20 minutes before sun rise. This bat and *P. dormeri* have been observed in Jodhpur in the same hunting territory exploring among old houses and trees.

Some information on food is given by Sinha and Advani (1976).

At Jodhpur, females with two sucklings youngs were found in August suggesting birth in August in Rajasthan. Sinha (1970) has reported female with suckling young in September from Calcutta.

Pipistrellus dormeri (Dobson)

This bat was observed in holes, cracks and crevices in ceilings and walls of old houses and temples at Dungarpur, Banswara and Jodhpur in Rajasthan and in holes of banyan trees (*Ficus bengalensis*) at Sukal Tirath (Bharoch Dist., Gujarat).

At Jodhpur, in summar it starts leaving the roost just after *Pipistrellus mimus mimus* (about 20 minutes after sunset). It was very active in the hunting territory up to 90 minutes after sunset and then disperses. It returns to the roost many times till it settles in finally before sunrise.

It was not found in association with other bats but observed in Surat, Gujarat in the same building in which other bats *viz. Cynopterus s. sphinx, Scotophilus h. heathi* and *T. k. kachhensis* live in different corners. Madhavan (1978) observed this bat often in association with other bats in Maharashtra.

There is no sexual segregation and both sexes are found in the same colony.

Pregnant females with one or two foetuses were found in July (early pregnancy) and September (advance pregnancy) in Jodhpur (Rajasthan). Madhavan (1978) mentions that this bat does not have sharply restricted breeding season but breeds throughout the year in Maharashtra.

Bugs (Cimicidae), ticks and mites are found as ectoparasites.

Scotophilus heathi heathi Horsfield

This bat was obtained from cracks, crevices and holes in walls and ceilings of buildings from various localities in Rajasthan. At Sawai Madhopur it was also collected from a hole in banyan tree. The size of colony was generally not more than 10 exs. but in Banswara a colony of 25 exs. was seen.

As mentioned by Brosset (1962 c), in Rajasthan (Bundi) also two females were found in a state of torpor in a big hole of a wall on a very cold day of December.

Sexual segregation is not common, but in Bundi the two sexes were found in separate colonies.

Some observations on food have already mentioned by Sinha and Advani (1976).

Nothing is known about its breeding from Rajasthan.

Ticks, mites and insects (Diptera: winged Streblidae and wingless Nycteribiidae; Hemiptera: bugs of family Cimicidae) were collected from this bat.

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REFERENCES

AGRAWAL, V. C. (1967): New mammal records from Rajasthan. *Labdev (J. Sci. Tech.)*,*5*: 342-344.

BROSSET, A. (1962 a): The bats of central and western India. Part I. *J. Bombay nat. Hist. Soc.*, *59*: 1-57.

——— (1962 b): The bats of central and western India. Part II. *J. Bombay nat. Hist. Soc.*, *59*: 583-624.

——— (1962 c): The bats of central and western India. Part III. *J. Bombay nat. Hist. Soc.*, *59*: 707-746.

GOPALAKRISHNA, A. (1955): Observations on the breeding habits and ovarian cycle in the Indian Sheath-tailed Bat. *Taphozous longimanus* (Hardwicke). *Proc. natn. Inst. Sci. India,* (B) *21*: 41.

KHAJURIA, H. (1965): A novel method for the capture of the Indian Flying Fox (*Pteropus g. giganteus* Brünnich) for meat, fur and control. *Chee-*

tal, 8: 37-39.

——— (1971): On the habits of the Indian Flying Fox, *Pteropus g. giganteus* (Brünnich). *Cheetal, 14*: 37-39.

——— (1975): Methods of suspension, crawling, swimming and defecation in Indian bats with remarks on possible causes of chiropteran head-down ward suspension. *Dr. B. S. Chauhan. Comm. Vol.*, 99-105.

MADHAVAN, A. (1978): Breeding habits and associated phenomena in some Indian bats. Part *V-Pipistrellus dormeri* (Dobson)-Vespertilionidae. *J. Bombay nat. Hist. Soc., 75*: 426-433.

PRAKASH, I. (1963): Taxonomic and biological observations on the bats of the Rajasthan desert. *Rec. Indian Mus., 59* (1961): 149-170.

SANDERSON, I. T. (1969): Living mammals of the world. Hamish Hamilton, London.

SINHA, Y. P. (1970): Taxonomic notes on some Indian bats. *Mammalia, 34*: 81-92.

——— (1976a): New record of the Indian Sheath-tailed bat, *Taphozous longimanus,* from Rajasthan with remarks on winter fat deposition in *T. kachhensis. Sci. & Cult., 42*: 169-170.

——— (1976b): Fat deposition in rat-tailed bats (*Rhinopoma* sp.) in Rajasthan, India. *J. Bombay nat. Hist. Soc., 73*: 206.

——— (1977): A new and a rare record of fruit bat (Pteropidae) from Rajasthan (Mammalia: Chiroptera). *Sci. & Cult., 43*: 264-265.

——— (1980): The bats of Rajasthan: Taxonomy and zoogeography. *Rec. zool. Surv. India., 76*: 7-63.

SINHA, Y. P. AND ADVANI, R. (1976): Notes on food and reproduction of some Rajasthan bats. *Geobios, 3*: 37-40.

FLORAL BIOLOGY OF *MIMUSOPS ELENGI* LINN.[1]

C. Subba Reddi and A. Janaki Bai[2]

(*With three text-figures*)

INTRODUCTION

There is practically no information on the floral biology of tropical plants. Further, to quote Percival (1965), "we do not know the complete floral biology of any species of plant. Some economic crops have attracted considerable attention, but even for these the data are incomplete. This means that any observer may amass original data and add to our knowledge in this field." The floral biology of *Mimusops elengi* has been therefore studied and its pollination potential ascertained in all its aspects.

RESULTS AND DISCUSSION

Mimusops elengi Linn. is grown in parks and road-sides because of its evergreen nature and of its beautifully scented flowers. The plants are mostly confined to tropics.

Morphology of the flower:—The flower morphology of *Mimusops elengi* was earlier described by cooke (1904), Gamble (1921), Bor (1953) and McCann (1959), but the descriptions are not from the angle of making a special study of pollination. Three types of plants of *Mimusops elengi* occur in nature. One type with flowers having only functional stamens (bearing no fruits); second type with flowers having functional ovaries only (bearing fruits); third type with flowers having both ovaries and stamens functional (bearing fruits). The following description of the flower is a generalised one.

The pedicillate flowers, either solitary or fasicled, occur in the axils of newly formed leaves, the blades of which do not completely unfold (Fig. 1). They are pendulous because of the curvature of their pedicels. Calyx persistent, consists of 8 lobes in two whorls of 4 each (the inner ones narrow and petaloid), valvate. Corolla scented, deciduous, white, tube very short, consists of 24 lobes in two series, the exterior of 16, linear spreading lobes, and the inner of 8 linear erect lobes.

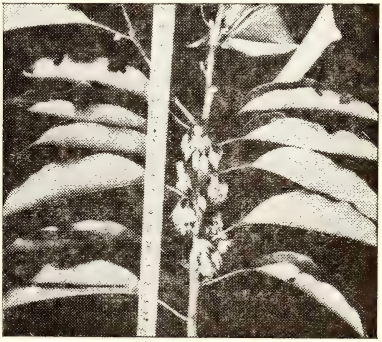

Fig. 1. Twig with pendulous flowers.

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The inner ones are narrow at the base but boader above (spathulate), each adpressing against one another; they are contiguous and convergent around the style. Aestivation of either series imbricate. Stamens inserted on the tube of the corolla, fertile ones opposite to calyx lobes and the inner lobes of the corolla; filaments slender, short; anthers lanceolate-sagittate, larger than the filament, 2-celled, dehiscing lengthwise, extrorse; sterile ones alternating with the fertile ones, ovate, acute, toothed, hairy at the base; ovary hirsute, 6-8 celled with one ovule in each locule but in the fruit only one ovule develops, others become suppressed, style cylindrical, exserted, stigma small, furrowed and provided with cylindrical papillae. Nectar produced at the base of the ovary.

Morphology of pollen grains: Pollen grains are monads, roughly spheroidal, dry, non-coherent, 30-45 μm in size (average of 100 grains 36 μm), (3)4(5) colporate, exine thin and smooth, contents granular.

Viability of pollen grains: Pollen grains readily germinated in 5% sucrose solution. They (50% of the grains) remained viable for 6 days under laboratory conditions.

Output of pollen grains: In estimating the pollen output, the method used by Subba Reddi (1976) was adopted. The number of pollen grains per anther varied from between 15,321 and 22,253, the weighted average being 19,933 (± 2148). There are 8 anthers in a flower and as such on an average 1, 59, 464 pollen grains could be produced per flower.

Pollen liberation: The style emerges before the calyx and corolla expand (Fig. 2). Even before the emergence of the style, the anthers were found to dehisce. However, the pollen grains are prevented from contacting the stigma because both are separated by the inner series of corolla lobes which are connivent forming a cone surrounding the style, thereby concealing the stamens. Even when the calyx and the outer series of corolla lobes stretch out, the inner series of lobes remain converging around the style. Because of this contrivance, though the flowers are pendulous and the anthers dehisce even when the flower is in the bud condition, the pollen grains are arrested from being poured down.

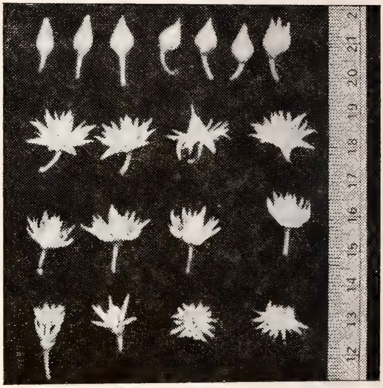

Fig. 2. Flowers showing the emergence of the style before the calyx and corolla stretch out, the convergence of the inner series of corolla lobes forming a cone around the style, and the deciduous nature of the corolla.

After a day or so depending on the prevailing weather conditions the flower begins to lose its turgidity and hence the inner series of corolla lobes become flexible. Consequently, a narrow way is formed between the tip of the corolla and the style. When there are requisite wind speeds to disturb the flowers sufficiently, the pollen grains escape through the narrow space formed between the tip of the corolla and the style, and are wafted by wind currents.

Unless the flowers are disturbed no release of pollen grains would occur. This had been verified in the laboratory. Twigs with flowers, the calyx lobes and the outer corolla lobes of which just unfolded, were brought to the laboratory and their cut ends were kept in a beaker of water. Microscope slides coated with glycerine jelly were placed just beneath the flowers. Under relatively still conditions no pollen grains were found deposited on the slides even after the corolla lobes become flexible. When the flowers were disturbed one could see the pollen coming out as a white powder.

To know whether or not all the pollen grains produced in a flower would get into the ambient air, batches of corollas with anthers that fell on the ground were kept in stoppered tubes immediately after collection. After bringing them to the laboratory, the usual procedure for estimating the number of pollen grains was followed. The number of grains in such fallen corolla varied per anther from between 1385 to 2771, the weighted average being 2128. This means that about 11% of the total pollen that could be produced per anther might remain unliberated into the air before the corollas drop off from the tree.

Terminal velocity of pollen grains: Terminal velocity was measured by releasing pollen grains at the top of a column of still air in a vertical glass cylinder of 160 cms in length and finding the time taken by them to arrive at the bottom. Calculations were made following Weinhold (1955).

The observed terminal velocity is 4 cm/sec.

Incidence of pollen grains in the air: To know the power of pollen grains to remain airborne, rod impactors of 0.53 cm diameter with 18 mm square sticky cellophane strips wound round them were exposed at a height of 2.5 m a.g.l. and at a distance of 25 m in the down wind direction (determined at the time of placing the impactor) of the tree in full bloom at Sitammadara in Visakhapatnam for 24-hour periods during April-May 1976. The exposed cellophane strips after mounting in glycerine jelly were scanned at 1 mm gaps across the stagnation line and the number of pollen grains thus counted on 81 sq. mm of trap surface were estimated to number on 324 sq. mm, the total trap surface. The re-

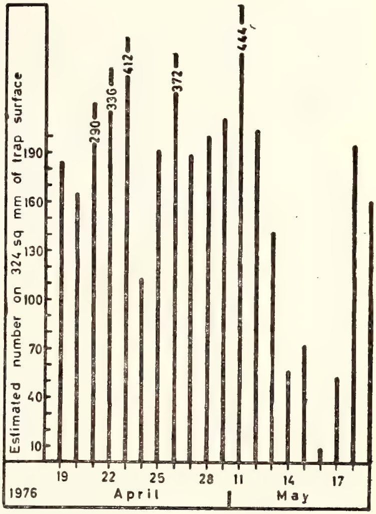

Fig. 3. Variations in the day-to-day incidence of pollen grains in the air.

sults presented in Fig. 3 indicate that considerable numbers of pollen grains could remain in suspension in air.

Pollination:—The disappearance of glistening of the stigma before the liberation of pollen grains indicating the loss of receptivity together with the occurrence of plants either with only functional stamens or with only functional ovaries undoubtedly indicate that the flowers in *Mimusops elengi* are cross-pollinated. Also the occurence of a mechanism for arresting the pollen grains from being liberated while the stigma is receptive is a good device for safeguarding cross-pollination. During these observations it was found that honey bees and other insects visit these flowers now and then. But they were seen to alight on such flowers which have already lost the receptivity of their stigmas. Hence the biotic factor apparently does not aid in the transference of pollen in this plant. The present observations suggest the possibility of wind as the agent of pollination.

In the literature there are certain conditions mentioned as most propitious for effective wind pollination. They are: (1) Flowers usually appear before the leaves are out (2) Flowers reduced in size and unisexual (3) Reduced perianth (4) No nectar or scent (5) Both anthers and stigma exposed (6) Production and release of large amounts of single (monads) grains; grains dry and round falling in the size of 20-40 μm, exine of grains thin, sculpture smooth (7) Terminal velocities range from 2-6 cm/sec. (8) Stigma feathered or branched (enlargement of stigma) (9) Reduction in number of ovules per ovary (10) Pollen release (hence flowering) should coincide with the most favourable time of the year (low probability of precipitation, adequate winds and turbulence) for transport to be effective (Kerner 1895; Knuth 1906; Percival 1965; Whitehead 1969; Faegri & Pijl 1971; Ehrendofer 1973).

It is remarkable that some of these traditional characters such as those under 1-5, 8 and 9 mentioned above are not met with *Mimusops elengi*. Nevertheless, the pendulous flowers and their peculiar structure with the inner 8 corolla lobes converging and forming a cone around the style, production of excessively large number of pollen grains (as a compensation for decreased probability of pollination by the wind) and the improvision of a mechanism for their liberation only during gusty winds together with their power of remaining airborne and their terminal velocity falling within the required range speak undoubtedly in favour of wind as the agent of pollination. The relatively large size of the pollen grains is well suited for their deposition on the stigma by impaction (Gregory 1973). Further, the period of flowering (March-May), with considerably high wind speeds and no precipitation provides adequate turbulence for the effective transportation of pollen grains by the wind.

This is a second instance of anemophily where all the traditional characters associated with the syndrome of anemophily are not seen, the first being *Madhuca indica*, reported by the senior author (Subba Reddi 1976).

SUMMARY

The floral biology of *Mimusops elengi*, a tropical plant, has been studied. The pendulous flowers are protandrous. The inner series of corolla lobes are spathulate, each adpressing against one anther; they are contiguous and convergent around the style. The 8 epipetalous stamens are concealed and the an-

thers dehisce longitudinally. The style comes out well before the unfolding of the perianth lobes.

Pollen grains are produced in abundance, the average number per anther being 19,933. The grains are monads, dry, non-coherent, and 36 μm in size. They remain viable for 6 days. Their terminal velocity is 4 cm/sec. An efficient mechanism is improvised for the liberation of pollen grains during gusty winds only. Evidence is in favour of wind as the agent of pollination, and the grains being slightly larger have the advantage for deposition on the stigma by impaction.

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REFERENCES

BOR, N. L. (1953): Manual of Indian Forest Botany. Oxford University Press.

COOKE, T. (1904): The flora of the Presidency of Bombay, Vol. II, Reprinted Edition, Botanical Survey of India, Calcutta.

EHRENDOFER, F. (1973): Adaptive significance of major taxonomic characters in angiosperms, In Taxonomy and Ecology, edited by V. H. Heywood, Academic Press, London-Newyork.

FAEGRI, K. & PIJL, L. VAN DER (1971): The principles of pollination ecology. 2nd Revised edition. Pergamon Press Ltd.

GAMBLE, S. J. (1921): Flora of the Presidency of Madras, Vol. II, Reprinted Edition, Botanical Survey of India, Calcutta.

GREGORY, P. H. (1973): The microbiology of the atmosphere, 2nd edition, Leonard Hill.

KERNER VON MARILAUN, A. (1904): The Natural History of Plants. Transl. F. W. Oliver, Vol. II, The Gresham Publishing Company, London.

KNUTH, P. (1906): Handbook of flower pollination. Transl. J. R. Ainsworth Davis, Clarendon Press, Oxford.

MCCANN, C. (1959): 100 Beautiful plants of India. A descriptive and pictorial handbook. D. B. Taraporevala Sons & Co. Private Ltd.

PERCIVAL, M. S. (1965): Floral Biology. Pergamon Press Ltd.

SUBBA REDDI, C. (1976): Floral mechanism, Pollen Productivity and pollen incidence in *Madhuca indica* Gmelin with remarks on the mode of pollination, *New Botanist, 3*: (1 & 2): 11-16.

WEINHOLD, A. R. (1955): Rate of fall of uredospores of *Puccinia tritici* Erikss. and Henn. as affected by humidity and temperature. Technical Report ONR Contract No. Ng onr 82400, Task order 82402.

WHITEHEAD, D .R. (1969): Wind Pollination in Angiosperms: An Evolutionary and Environmental Considerations. *Evolution, 23*: 28-35.

SOME OBSERVATIONS ON TIGER BEHAVIOUR IN THE CONTEXT OF BAITING[1]

CHARLES McDOUGAL[2]

(*With a text-figure*)

This paper deals with the response of tigers to regular baiting, that is, the provision of a steady and localized food supply in the form of young buffaloes tethered at specific sites in localities frequented by tigers, where disturbance is minimal. The primary objective of the baiting has been to afford tiger viewing by tourists. Nevertheless, the baiting situation also may be viewed as a type of experiment which holds constant many environmental factors so that individual response may be assessed and the range of behaviour determined. It provides an opportunity for making quantitative observations on certain aspects of behaviour not possible by other field methods.

The Record from Baiting at Tiger Tops: 1972-79

Tiger Tops Jungle Lodge, located in Nepal's Royal Chitawan National Park, has been regularly baiting for tigers since 1965, but no records were kept before I joined the staff in 1972. Since then I have been able to document the response of different indvidual tigers to the baiting situation. Young male buffaloes are tethered at fixed places almost every night from October through June. In the beginning I continued to bait throughout the monsoon also, for I then believed that this practice would habituate the tigers to the baits and ensure that their visits became regular. However, I discovered that monsoon baiting had no effect on the frequency with which baits were visited for the remainder of the year, so it was discontinued.

The first essential of any serious study of these animals is the ability to recognize individuals. Tigers have distinctive facial and other individual markings, and so can be identified by careful observation. This is facilitated by the baiting situation when they can be seen for prolonged periods. Observations are made from blinds overlooking the baiting sites at distances of approximately 50 metres, using powerful binoculars, aided at night by a spotlight—to which, incidentally, the great majority of tigers react very little. Tigers positively identified by individual markings are counted as having visited the bait site; doubtful observations are discarded.

My records cover the two bait sites near Tiger Tops Jungle Lodge which have been used at more or less the same locations continuously since 1972 (and even prior to that when no records were kept); a site used at Mohan Khola near Tiger Tops Tented Camp from 1973-76; and finally a site used on Bandarjhola Island, where the Tented Camp was shifted, from 1976-79.

A total of 17 individual tigers, excluding dependent young, have been identified at one or more of these sites during 1972-79, nine males and eight tigresses.

Many persons believe that baiting overtime

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[1] Acecpted October 1979.

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results in important changes in the behaviour of the tigers concerned. The most common assumptions are: (1) that it leads to a dependence on the baits on the part of the tigers; (2) that it causes an artificial concentration of tigers in the area where baiting occurs; and (3) that it leads to increased intra-specific aggression, with resultant casualties to the tiger population. Before setting down the results of the study, it is necessary to demonstrate that none of these assumptions is correct, using what certainly is the most comprehensive record of baiting that is available. While I do not deny that tigers are attracted to baits—especially under certain circumstances which will be discussed later—I contend that the overriding dictates of this super predator's adaptive strategy, successfully evolved over a long period of time, prevent these changes in behaviour from taking place.

The Question of Dependency

Since baiting only is done for nine months of the year and discontinued for three, the question of complete dependence does not arise. Moreover, there is ample evidence that, while a given individual may make frequent use of the baits for a temporary period to supplement natural prey, a change in circumstances unrelated to the baiting situation may cause that tiger to revert almost completely to natural prey. Let me cite a few examples.

The two resident tigresses exposed to the baiting situation for the longest periods are one named Chuchchi, who has maintained a home range in more or less the same area from 1972-79 (and who since 1978 has been radio-collared by the Smithsonian Tiger Ecology Project); and another named Bangi, first identified in 1974, since when she has been Chuchchi's western neighbour.

During a four and a half year period from mid-1974 to the end of 1978, there has been a complete reversal in the relative frequency with which these two tigresses have been observed at the bait sites. During the first two years Bangi was seen 43 times and Chuchchi only five times—sometimes Bangi even was seen at the eastern, Surung, bait site, well within Chuchchi's home range. When this period began, Bangi had small cubs, while Chuchchi lacked cubs. Chuchchi bore a litter a year later (mid-1975), after which Bangi stopped using the Surung site; thereafter the site further west at Dhakre Khola was the only one used jointly by the two tigresses.

During the next year, mid-1976 to mid-1977, Bangi and Chuchchi were seen with almost equal frequency, the former seven times and the latter eight times. Neither had cubs during this period, those of Bangi having become independent and those of Chuchchi having disappeared without a trace before reaching a year of age.

Then, in mid-1977 Chuchchi had another litter. During the two years which followed she was seen at the bait sites 29 times, most often when her cubs became large. Bangi bore cubs a couple of months after Chuchchi. Nevertheless, she was not observed even one time during the same two-year period, despite the fact that she patrolled on many occasions up to Dhakre Khola—the boundary between the two tigresses' territories since mid-1975—where baits are regularly placed.[3]

In this example the food supply has remained the constant factor. Nevertheless, the individual responses of the two tigresses varied inversely. This was due to factors not directly related to the baiting situation. These factors are outside the scope of this paper, but we may state parenthetically that dominance is almost certainly one of them, and moreover that dominance appears to be relative, and to be linked with reproductive status. A tigress having young cubs may be dominant over one lacking cubs, and may maintain her dominance even if the latter produces a litter a short time later. However, the point to make here is that although Bangi was a regular visitor for two years there is no question of her having become dependent on the baits, for since she stopped using them she has been living successfully on natural prey and has managed to raise a litter of three cubs to the point where they now (April 1979) are able to kill for themselves.

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[3] Although not observed at the regular bait sites, Bangi was seen three times at a special site further west used for filming.

Another example is that of the large male tiger No. 105 (radio-tagged by the Smithsonian project). He first appeared in western Chitawan in September 1976 shortly after the death of the former resident male who previously had been his western neighbour; he began to extend his movements in an attempt to include most of the dead tiger's former territory within his own. At maximum expansion (February 1977) he ranged all the way from Saurah in the east to Mohan Khola in the west, a linear distance of over 40 km. Within a year he impregnated six known tigresses and possibly a seventh. During that year he was observed five times at our bait sites. The next year (mid-1977 to mid-1978) his westward movements were more restricted, another male having established himself west of Dhakre Khola, but he still included the home

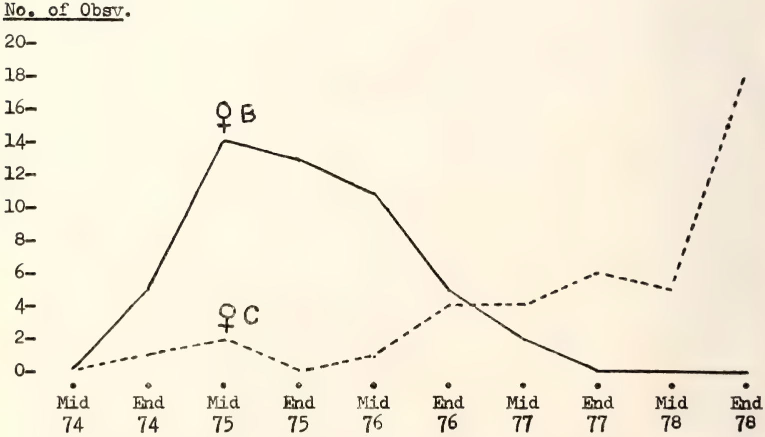

Fig. 1 Relative Frequency of Observations of Tigresses Bangi and Chuchchi at Bait Sites.

ranges of six resident adult tigresses within his territory, and had access to one or two others. He impregnated two of the resident females (one for the second time). He was seen at Tiger Tops bait sites no fewer than 27 times. Nevertheless he continued to patrol his extensive territory, making an average of three trips per month between his eastern and western boundaries, on one occasion covering 20.5 km in less than 12 hours.[4] During the first half of the year he also occasionally used baits put out by the Smithsonian project at Jarneli on the eastern side of the park; even after baiting was discontinued there he continued his patrols to that area with some regularity. One was tempted to say that, far from tending to localize him, the use of baits—together with an east to west road down the long axis of the area over which he ranged—facilitated the maintenance of a large territory. However, the last—not quite complete—year (mid-1978 through March 1979) he has been seen only eight times. During this period he re-mated with five known females.

While allowing that the bait sites, and the resource which they provide, are an attraction, used most frequently during a critical period of the animal's life cycle, we find no evidence that individual tigers become dependent on this easy, regular, and localized supply of food.

The Question of Artificial Concentration

The first point to make here is that tigers are territorial animals; they maintain their territories, patrolling and marking them, whether they come to the bait sites or whether they do not.[5] Were the use of baits to affect the tiger's ability to maintain its territory, then one would expect that those individuals that visit bait sites would have smaller territories than others. This is not so, since even baited tigers only use this resource when they visit the area in the course of normal patrolling—the remainder of the time they are visiting other parts of their territories. All evidence indicates that the territories of tigers in western Chitawan having access to sites which are regularly baited are just as large as those in eastern Chitawan where they do not. One eastern resident adult tigress monitored by radio-telemetry for 14 months in 1975-76 maintained a territory of 30 km²; another monitored for 12 months one of 26 km² (Sunquist, Tamang, and Troth 1976: 7). During roughly the same period, of two resident western females whose movements I monitored by pugmark tracking, one used an area of 30 km² and the other one of 39 km² (McDougal 1977: 69). Radio-tagged male 105 at the eastern end of the park covered 62 km²; the Dhakre Tiger (102) moved over 100 km.². More recently, of six radio-tagged tigresses monitored by Smith the largest territory was that of the tigress Chuchchi (23.5 km²), who during that period used both of the bait sites near Tiger Tops Lodge (Smith 1978: 15).

The density of tigers in western Chitawan, where regular baiting occurs, is not greater than in the eastern part of the park. Secondly, although the total number of tigers in western Chitawan has fluctuated over the years due to births, deaths, and dispersal, the number of resident adults has remained almost constant.

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[4] This is based on a combination of radio tracking by the Smithsonian project and pugmark tracking by myself. The data on some of the pregnancies were provided by David Smith of the Smithsonian project; others are from my own observations. See Smith 1978.

[5] Male tigers maintain large home ranges which encompass the smaller ones of several females. In both cases the entire home range, held more or less exclusively with little overlap, and defended by advertisement, may be considered a territory.

The example of male 105 given in the preceding section shows that a bait site does not localize an animal. The tigress Bangi used as large an area during the time she was visiting the bait sites as that which she ranged over during the two years since her visits stopped.

The Question of Increased Aggression and Mortality

The third allegation is that regular baiting leads to more intra-specific aggression as tigers compete for the important resource afforded. From 1973 to the present we have observed two or more tigers (excluding dependent young) associated at a kill of one of the baits on no fewer than 88 occasions. Aside from occasional growling/snarling, and even this in a minority of observations, only two displays of aggression have been seen.

Tigers view these meetings at kills as situations of potential conflict, and have evolved behaviour for such occasions which minimizes the possibility of conflict actually taking place. Typically one animal feeds at a time, while the others lie spaced out, a few metres apart, scrupulously respecting individual distance. Also there is tacit recognition of the prior right to the prey by the tiger that killed it, as first pointed out by Schaller (1967: 250), and confirmed by my own observations, at least in principle (McDougal 1977: 141-42). A tiger arriving in the vicinity of the kill site when another already is present, advertises its lack of aggressive intent by an almost ritualized approach.

Selectively tolerant, tigers will associate amicably with certain conspecifics at kills, but not with others. The factors involved are not all clear, but competition is one of them. Noncompetitors may be tolerated, competitors are not. Males compete among themselves for females, while females compete for land/food resources for raising their young. Kinship also is a factor. Fathers tolerate sons and mothers daughters until such time as the offspring begin to become competitors.

It is true that tigers who are competitors may visit the same bait site, but they do so at different times. Their behaviour is calculated to avoid confrontations. Nevertheless, mistakes do happen and competitors meet. I know of two instances in which a young subadult tiger was chased away from a baiting site by an older male; in neither case did he ever return there.

Aside from one case in 1970 when two cubs less than a year of age were killed by an intrusive male close to a bait site, 14 years of regular baiting by Tiger Tops has resulted in no fatalities or even serious casualties.

Sex and Age Variation in Response to Baits

In my opinion we can use the baiting situation as a type of experiment which may shed light on a number of different aspects of tiger behaviour. One factor, the food resource provided by the baits, is held constant. Against this we can test the variability of other factors. To illustrate this, I consider two examples, the first being sex/age variation and the second seasonal variation.

To examine sex/age variation we will look at the six year period mid-1972 to mid-1978. The sex age categories are adult male, subadult male, adult female, and subadult female. We are excluding dependent young. Subadults are 18-36 months of age, adults over three years of age (any tiger reaching the age of three during the course of a given year is counted as adult for that entire year). The sex/age breakdown year by year is as follows:[6]

	72-73	73-74	74-75	75-76	76-77	77-78	Total	Per cent
A Male	—	2	2	1	1	3	9	25.0
SA Male	1	1	—	—	3	—	5	13.9
A Female	2	3	4	3	3	3	18	50.0
SA Female	—	1	—	1	2	—	4	11.1
Total	3	7	6	5	9	6	36	100.0

The number of observations of tigers in each category is shown below:

	72-73	73-74	74-75	75-76	76-77	77-78	Total	Per cent
A Male	—	51	23	16	20	58	168	27.1
SA Male	18	77	—	—	124	—	219	35.0
A Female	6	77	58	31	27	14	213	34.2
SA Female	—	8	—	2	13	—	23	3.7
Total	24	213	81	49	184	72	623	100.0

One major point is that if we lump together adults and subadults, females are a higher proportion (61 per cent) of the total number of tigers than are males (39 per cent). Nevertheless, far more males (62 per cent) were seen than females (38 per cent), inversely proportionate to their representation in the sample. The second thing that stands out is that subadult males were observed more often than any other category even though they constitute only a small proportion of the sample.

Were all other factors held constant, we might expect that the number of observations of each sex/age category would be proportional to its representation in the total number of tigers using the baiting sites. Actual observations are compared with expected frequencies below:

	Expected	Actual
A Males	156 (25.0%)	168 (27.1%)
SA Males	87 (13.9%)	219 (35.0%)
A Females	311 (50.0%)	213 (34.2%)
SA Females	69 (11.1%)	23 (3.7%)
Total	623 (100%)	623 (100%)

Although the number of actual observations corresponds closely with the expected number in the case of the adult males, this is not true of any other category. There were two and a half times more observations of subadult males than would have been expected from their representation in the total number of tigers. On the other hand, both categories of females were observed much less frequently than would have been expected.

Focusing on adult females, if we divide them into those having offspring one to two years old, on the one hand, and those having younger cubs or no offspring, on the other, we find a significant difference.

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[6] These figures differ slightly from those given in a different version of this paper presented at The International Symposium on Tiger in New Delhi in Februay, 1979, due to an error in calculation in that paper for the year 1976-77.

	Expected	Actual
Adult females with 1-2 year old offspring	68 (11%)	105 (16.9%)
Adult females with young cubs or no offspring	243 (39%)	108 (17.3%)

Females with large offspring were observed more frequently than would have been expected from their representation in the total, other tigresses much less frequently.

We may say that the different sex/age categories of tigers are attracted to the baits in the following order, indicating what percentage of the expected frequency was realized by empirical observation:

Subadult males	252%
Adult females with 1-2 yr old cubs	154%
Adult males	108%
Adult females with small cubs/ no cubs	44%
Subadult females	33%

These findings pose some challenging questions. Why the dichotomy between males and females generally? The answer must be that it reflects the different roles/strategies of the two sexes. All available evidence indicates that the ratio of the sexes at birth is parity. In a sample from Royal Chitawan National Park, where seven known tigresses had 20 cubs at an average age of nearly 14 months, the ratio was 3:2 in favour of males. However, in the adult population the ratio is 4:1 in favour of females. This strongly indicates that a high proportion of male mortality occurs during the subadult phase of life; attrition on subadult females is less. Few subadult males that strike out on their own after independence survive to establish territories of their own, most of them dispersing to the periphery where habitat is suboptimal and natural prey more difficult to secure. Competition is intense, and continues into adulthood—on the part of those who survive—as males compete for larger territories containing more females. Although caution and discretion are essential to any tiger's survival, within the context of intra-male competition, bold and enterprising behaviour probably is adaptive. This is reflected by the greater activity of males at bait sites. A male is most attracted to the baits during that critical, transitional, and very vulnerable period when he is a subadult. If he survives to grow into an adult and manages to establish a territory of his own, then he cannot afford to localize himself in the vicinity of a bait site. Otherwise he will not be able to maintain his territory and visit the tigresses it contains. If he is not out there patrolling and marking his territory, it will not be his for long. So long as he does this he may regularly use a bait site in the course of patrolling an area which contains one, but soon moves off to another area. In fact, the use of baits from time to time, saving energy which would otherwise be expended in the pursuit and capture of natural prey, may even facilitate better territorial patrolling.

The female, on the other hand, ensures her survival and that of her offspring especially by maintaining a low profile. Having a smaller range her use of it is more intensive, more fine-grained as it were, than in the case of a male who must cover large distances and keep up the pace to frequently visit all the different parts of his territory. As a rule the female cub becomes independent somewhat later than the male cub, consequently benefiting from a longer period of maternal training, including the art of keeping out of trouble. One resident tigress, Bangi, invariably runs off like a shot the moment a light is shined on her, no doubt the result of a nasty experience in her past. It was interesting to note that her female cub also took to doing this, whereas the males did not.

When a tigress has small cubs she is especially cautious and secretive. But a female with large, but still dependent offspring may experience difficulty in securing sufficient food for them. At the same time, by virtue of their size, the cubs are less vulnerable than previously. A tigress with such offspring finds the baits more attractive than do other tigresses.

Seasonal Variation in Response to Baits

Tigers are not observed uniformly throughout the months of the year when baiting is done regularly, i.e., October through June. Observations rise to a peak in the spring and then decline in frequency well before the monsoon. This is true of all sex/age categories.[7]

	O	N	D	J	F	M	A	M	J	T
A Males	7	9	21	18	22	27	22	18	12	156
SA Males	3	16	14	21	35	52	39	20	19	219
A Females	14	20	17	23	24	41	32	35	5	211
S Females	1	1	—	2	6	8	2	3	—	23
Total	25	46	52	64	87	128	95	76	36	609

Looking at the month by month totals of all categories, over half (51 per cent) of the observations of tigers at the bait sites occurred during the three month period from February through April; the peak for all categories was March.

This period coincides with the time in Chitawan when the vegetation ground cover is most reduced as the result of annual fires that burn off the grassland and, to a lesser extent, forest undergrowth. A peak in tiger observations at baits at the very time when ground cover is most limited strongly suggests that these cats are most attracted to the resource provided by the baits when their natural prey is least vulnerable. This correlation is reinforced by examining the records of observations of dependent young tigers, aged eight to sixteen months, that we from time to time made at our bait sites. If the baits are especially attractive when natural prey vulnerability is lowered, then this should be particularly true for a tigress with growing cubs to feed. In fact, 73 per cent of the observations of such cubs were made during the two months of March and April.

Nevertheless, even at this time of the year the tigers are not dependent on the baits. This can be illustrated by the incomplete year record mid-1978 through March 1979. At the two sites near Tiger Tops Lodge there were 63 observations of tigers during the four months October through January. Then suddenly the number fell from 21 in January to only two in February and one in March, the normal peak. Other events took priority over the attraction of the baits during this year. Towards the end of January the tigress Chuchchi had a new litter of cubs after an interval of only 19 months since her last ones were born. The latter had been visiting one of the bait sites regularly, in particular the young male who had been killing on his own for a few months. These offspring dispersed out of the area in January and have not been seen since. Chuchchi herself was not observed at the bait sites at all during February and only once in March. Again towards the end of January the two resident males had a fight west of Dhakre Khola in a area where their respective territories slightly overlap, at a time when one of them was mating with the tigress

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[7] The total figure of 609 omits 14 observations made during the months of July through September.

Bangi. Both were wounded in the fight, but neither seriously so. The western male had been seen ten times at the Dhakre bait site in the preceding four months; he was seen there only once in February and not at all in March. The eastern male who before had been observed seven times at the two Tiger Tops Lodge bait sites likewise was only seen once in February and not even one time in March.

All of these tigers have reverted almost entirely to natural prey, and have done so very abruptly; there is no evidence that they experienced any difficulty in the process. To cite a final case, a subadult male who was observed at bait sites no fewer than 37 times in 1976-77 thereafter disappeared. Suddenly he reappeared briefly in January 1979 after an absence of 19 months and was observed three times before disappearing again. During the interval he subsisted entirely on natural prey. When seen again he looked in prime condition.

DISCUSSION

To summarize, by recording the visits of identified individual tigers to bait sites it has been possible to quantify the differential response to this resource on the part of four sex/age categories, and to determine that males are more attracted to baits than females generally, although tigresses with large, dependent cubs are frequent visitors. Subadult males, however, are those most attracted, being seen more frequently than any other category despite the fact that they form only a small proportion of the total number of animals using the bait sites. Secondly, it has been determined that all four sex/age categories of tigers are most attracted to the baits when ground cover is most reduced by the action of fire—and presumably when natural prey species are less vulnerable to these large, stalking predators.

There is no evidence that regular baiting has the results sometimes suggested: dependence on the baits, artificial concentration, and increased aggression. This is simply because tigers are subject to overriding pressures strong enough to prevent these things from happening.

Dependence on baits would be non-adaptive. The survival of the fittest means that some individuals are able to increase the proportion of their genes in subsequent generations. The male tiger, competing with others of his own sex, maximizes his genetic contribution by impregnating as many females as possible, and also by providing a stable situation for those tigresses to successfully raise his offspring. This he does by establishing a territory large enough to contain several tigresses, but not so large that he cannot effectively maintain it. Failure to do so will result in the intrusion of another male, who may cancel out his genetic contribution by killing or prematurely ejecting his offspring, and who will mate with the females. The adult male cannot afford to remain localized in the vicinity of a bait site; the consequence will be failure to maintain his territory. (However, the occasional use of a bait site during the course of normal patrolling activity may conceivably help the tiger to maintain it.) The subadult male, being non-reproductive and lacking a territory, is not subject to the same constraints; the resource afforded by the baits may enable him to hang on during that critical period before he is able to establish a place for himself.

A tigress ensures that her genes get into subsequent generations by successfully raising her offspring. She needs an area which is free from competitors where she can train her young for survival and at the same time keep them out of harm's way. There is less demand on her time to maintain her territory because it is much smaller than that of the male, but neither can she afford to remain too localized, as this increases the vulnerability of her cubs, at least when they are small. The more cautious and secretive she is, the less risks to which she subjects the cubs, the better the chances they will survive to the point where they can fend for themselves. She cannot afford to rely on baits if she is going to raise her offspring successfully, although they may help her through a critical period when the cubs are large enough to have lost much of their vulnerability but still are primarly dependent on her for food, especially during that time of the year when it is most difficult to secure natural prey, and also especially if her litter is a large one.

Baiting does not result in artificial concentration of tigers in the vicinity of a bait site over any period of time due to the very efficient spacing behaviour which tigers have evolved, behavior which appears designed to prevent the population from rising in response to temporary abundance of prey. If the number of predators was geared to the time when prey was most available, the predators would be in serious trouble when prey was least abundant. These highly adaptive patterns of behaviour are not going to be changed by a few years of baiting.

Increased aggression does not result from baiting because tigers long ago evolved behaviour to deal with such situations, behaviour which minimizes the possibility of conflict. An essentially solitary animal dependent on its own efforts to secure food, the tiger cannot afford the luxury of uninhibited aggression; incapacitation is probably a death sentence. Well armed, but thin skinned, it is difficult to inflict injury on a conspecific without the risk of receiving injury. Tigers visiting the same localities know one another individually. There are some with whom an encounter to share a kill may be tolerated or perhaps even enjoyed, but in these cases a dominance order and the demonstration of friendly intentions reduce the chances of a conflict. There are others with whom an encounter is to be avoided. Marking and other means of advertisement help to avoid confrontations.

REFERENCES

McDougal, C. (1977): The Face of the Tiger. Rivington Books and Andre Deutsch, London.

Schaller, G. B. (1967): The Deer and the Tiger: A Study of Wildlife in India. University of Chicago Press, Chicago.

Smith, J. L. D. (1978): Smithsonian Tiger Project/World Wildlife Fund Project No. 1051: Report No. 13 (mimeographed).

Sunquist, M. E., Tamang, K. M. and Troth, R. G. (1976): Smithsonian Tiger Ecology Project, World Wildlife Fund Project No. 1051: Report No. 11 (mimeographed).

NEW DESCRIPTIONS

DESCRIPTION OF A NEW SPECIES *DROSOPHILA GANGOTRII* (DIPTERA: DROSOPHILIDAE) FROM SOUTH INDIA[1]

N. Muniyappa and G. Sreerama Reddy[2]

(With seven text-figures)

INTRODUCTION

Coorg district is a part of the humid belt of hilly or mountainous country of Western Ghats with variable altitudes ranging from 900—1200 metres. The mountainous range facing the Western side is on the threshold of south-west monsoon and receives a full blast of rainfall that has favoured the growth of thick tropical forests. The access to the interior is not easy since the valleys are surrounded by deep gorges. The sheltered locations of the gorges with rivulets provide many natural habitats for the colonisation by *Drosophila* species. The investigations carried out on the *Drosophila* fauna of such places has yielded number of *Drosophila* species in addition to a new species *Drosophila gangotrii* which is herein described.

Drosophila gangotrii sp. nov. (Figs. 1-7)

Body length: Males 2.2 mm, Females 2.4 mm.

Head, ♂ and ♀: Arista with 9 branches (6/3) including the terminal fork. Front pale brown. Antenna yellowish brown. Basal segment of the antenna dark tan. Carina narrow. Palpi yellowish with single stiff bristle. Greatest width of cheek 0.15 times greatest diameter of eye. Orbital bristles in the ratio 3:1:3. Inner verticals longer, outer verticals small and three fourths the inner. Ocellar triangle broad with a pair of long ocellar bristles. Eyes red.

Thorax, ♂ and ♀: Light brown, Acrostichal hairs in eight rows, regularly arranged. Ratio; anterior: Posterior dorsocentrals 0.5. Scutellum dark brown. Anterior scutellars convergent. Posterior scutellars crossed. Sterno-index 0.5. Prescutellars absent.

Wings, ♂ and ♀: Smoky and hyaline. *C*—index, 1.9, *4V*—index, 2.6, *5X*-index, 3.00, *M*-index, 1.00 (wing indices calculated after Bock, 1976). 3rd costal section with heavy setation on basal 0.5. Wing lengths 1.6 mm (male), 1.7 mm (female), Halteres small, yellowish.

Legs. Pre-apical bristles on all tibiae. Apicals on first and second tibiae. Sex-comb of male (Fig. 1) longitudinal along the entire length of metatarsus and second tarsal segment. Metatarsal comb consisting of 26-29 teeth, basal teeth are small and contiguous, the distal two displaced from axis of remaining teeth. Comb on second tarsal segment with 13-17 uniform teeth. The distal teeth are contiguous.

Abdomen ♂ and ♀: Tergites of both sexes yellowish with five distinct narrow apical bands in female and three in male. The last tergite of female is yellowish while the remainder tergites of male are shiny black. The variability in the intensity of pigmentation of the apical bands in females is commonly observed.

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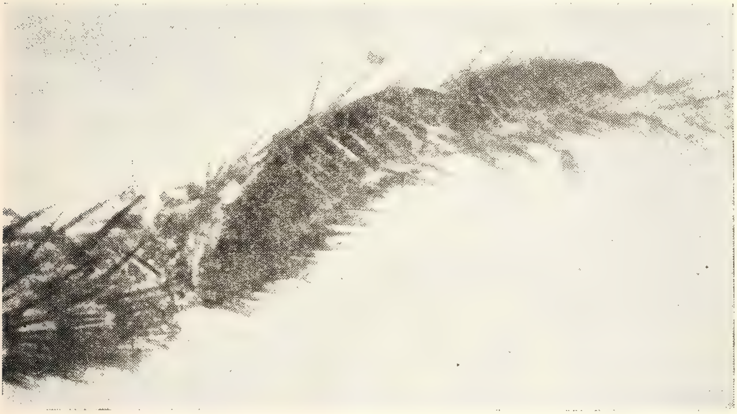
Periphallic organs (Fig. 2). Epandrium (Genital arch) broad and black dorsally, narrow and pale ventrally. Toe small, round with 4 bristles. Primary and secondary surstyli (claspers) present. Primary surstylus yellow, broad with 5 regularly arranged lateral teeth and a ventromedial cluster of 7 teeth, inner one is long and curved. Secondary surstylus partially separated from cerci (anal plate) with 3 curved black teeth, of which lower one is short and a row of 5 chitinoid bristles on the dorsolateral borders and 2 smaller bristles on the ventrolateral margin. Cerci light black with 16 bristles.



Drosophila gangotrii sp. nov.
Fig. 1. Fore leg of male showing sex-combs.

Phallic organs: (Fig. 3) Aedeagus yellow, non bifid, straight with denticles. Anterior gonapophyses (anterior parameres) triangular with sensilla. Posterior gonapophyses (posterior parameres) long and slender reaching the tip of aedeagus. Caudal margin of novasternum with median truncate process, apically with a pair of submedian spines. Basal apodeme not projecting the anterior border of ventral fragma.

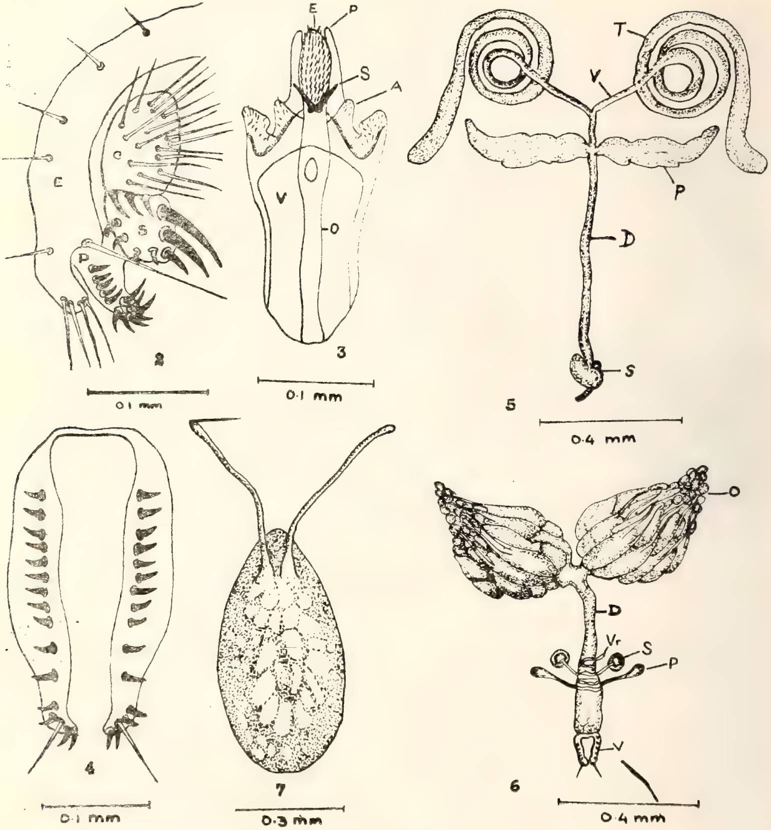
Egg-guide: (Fig. 4) Brown with 15 teeth and a sub-terminal hair.

Internal structures: Testes (Fig. 5) Yellowish with 3 coils. Accessary glands large and transparent. Spermathecae (Fig. 6) vestigial. Paraovaria small, ventral receptacle long, tightly coiled. Malpighian tubules 2 pairs and free.

Egg filaments: (Fig. 7) 2 long slender filaments.

Pupae: Anterior spiracle with 9-10 branches.

Distribution: Coorg district (Western Ghats), Karnataka, India.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Drosophila gangotrii sp. nov.

Fig. 2. Periphallic organs: C = Cerci, E = Epandrium, S = Secondary surstylus, P=Primary surstylus. Fig. 3. Phallic organs: A = Anterior gonopophyses, E = Aedeagus, O = Ejaculatory apodeme, P = Posterior gonopophyses, S = Submedian spine of novasternum, V = Ventral fragma. Fig. 4. Egg guide. Fig. 5. Male Reproductive organs: D = Anterior ejaculatory duct, P = Paragonia, S = Sperm pump, T = Testes, V = Vas deferens. Fig. 6. Female Reproductive organs: D = Oviduct, O = Ovary, P = Para ovaria, S = Spermatheca, V = Vagina, Vr = Ventral receptacle. Fig. 7. Egg.

Taxonomic status: The presence of 2 egg filaments, the nature of banding pattern of abdominal tergites and the puparia warrants its inclusion in the sub-genus *Sophophora.* The characters like the presence of long ventral receptacle, coiled testes, convergent scutellars and two pairs of malpighian tubules qualify its inclusion in the *melanogaster* species group (Patterson and Stone 1952). Further the prominent sex-comb extending beyond the tips of the tarsal joints, presence of 2 claspers in the male, secondary surstylus with curved black median teeth permit its inclusion in the *montium* sub group (Bock and Wheeler 1972).

Relationships and Remarks.

The new species shows certain similarities with *Drosophila punjabiensis* Parshad and Paika 1964, and *Drosophila jambulina* Parshad and Paika, 1964, but differs from them in several features (Okada personal communication, 1980). On comparison with other members of the *montium* sub group, it is found that it resembles *Drosophila nagarholensis* Prakash and Reddy, 1980 and *Drosophila agumbensis* Prakash and Reddy 1979, in the pattern and arrangement of sex-comb teeth and in the general feautres of periphallic and phallic organs. Even though the new species resembles the above mentioned species in gross morphology, it not only differs from them in certain details in male genitalia, pattern of abdominal pigmentation, sex-comb and wing indices but is also found to be sexually isolated. Therefore it deserves the status of a new species. The new species can be cultured in the laboratory with usual standard wheat cream agar medium. The specific name *Drosophila gangotrii* is coined after Manasa gangotri campus of the University of Mysore.

Holotype ♂, India, Karnataka, Coorg district (Western Ghats) 25.ii.1980. Coll. N. Muniyappa, G. Sreerama Reddy, H. S. Prakash, D. Theerthaprasad and B. M. Sekharappa. *Paratypes*: 10 ♂♂ and 10 ♀♀, same data as holotype. The holotype and some paratypes are deposited in the Department of Zoology, University of Mysore, Manasagangotri, Mysore. Other paratypes are also deposited in the Department of Biology, Tokyo metropolitan University, Setagayaku, Tokyo, Japan and in the Zoological survey of India, Calcutta and some will be deposited in the I.A.R.I., New Delhi.

ACKNOWLEDGEMENTS

We are grateful to Prof. N. B. Krishnamurthy, Head of the Department of Zoology, Manasa gangotri, University of Mysore, Mysore for providing necessary facilities and encouragement to carry out the work. We thank Prof. T. Okada, Tokyo, metropolitan University, Setagaya-ku Tokyo, Japan, for his help in confirming the identification and to M. Rajendra for the preparation of drawings. One of us (NM) is thankful to the University of Mysore for the award of Teacher fellowship under F.I.P.

REFERENCES

BOCK, I. R. AND WHEELER, M. R. (1972): The *Drosophila melanogaster* species group. Univ. Tex. Publ. *7213*: 1-102.

PATTERSON J. T. AND STONE, W. S. (1952): Evolution in the genus *Drosophila.* The Macmillan Company. New York.

PARSHAD, R. AND PAIKA, I. J. (1964): *Drosophilid* survey of India II (Drosophila), Taxonomy and Cytology of the subgenus sophophora. *Res. Bull. Punjab Univ. 15*: 225-252.

PRAKASH, H. S. AND REDDY, G. S. (1979): *Drosophila agumbensis,* sp. nov. from Karnataka, South

India (Diptera: Drosophilidae). *Oriental Insects.* *12* (2): 259-263.

——— & ——— (1980): *Drosophila* fauna of nagarhole, South India, including description of a new species (Diptera: Drosophilidae). *Proc. Ind. Acc. Sci.* (Anim. Sci.) *89*: 235-241.

A NEW SPECIES OF HIGH ALTITUDE SPIDER OF THE GENUS *ERIGONE* AUDOUIN (FAMILY: ERIGONIDAE) FROM INDIA[1]

B. K. Tikader[2]

(*With six text-figures*)

The spiders of the genus *Erigone* (Family Erigonidae) are little known from India. The only species *Erigone pseudoyagans* Caporiacco (1935) was described from Karakorum area. Holm (1960) has published a comprehensive study on spiders of the family Erigonidae from East African Mountains and Locket and Millidge (1935) have described many European species of this family. The spiders of this genus are small and inconspicuous and their webs are irregular, generally made in the hollows of stones at high altitudes. Only by moving the stones and with careful observation can these tiny spiders be seen on their irregular webs.

While examining the spider collections received from Dr. R. K. Varshney, Superintending Zoologist, Zoological Survey of India, Calcutta, which were collected by him from Rohtang Pass, I came across a new species of spider of the genus *Erigone,* which is described here. It is the second species of this genus from India.

The type specimen will in due course be deposited in the National Collections, Zoological Survey of India, Calcutta.

Erigone rohtangensis sp. nov.

(Figs. 1-6)

General: Cephalothorax and abdomen brown, legs brownish green. Total length 2.50 mm. Cephalothorax 1.00 mm long, 0.80 mm wide; abdomen 1.80 mm long; 1.20 mm wide.

Cephalothorax: Longer than wide, convex, cephalic region high, narrowing anteriorly. Eyes pearly white, eight in two rows. Anterior row strongly recurved and posterior row nearly straight or slightly procurved. Sternum reddish brown, nearly triangular or heart-shaped. Labium wider than long, maxillae longer than wide, clothed with fine pubescence. Legs moderately strong, clothed with hairs and spine-like hairs, legs formula 1423. Male cephalothorax high and clothed with some spines as in text-fig. 5. Ventral side of femur of male palp provided with teeth like spines extending from base to one half of length as in text-fig. 6. Male palp with well-defined tibial apophysis apically as in text-fig. 6.

Abdomen: Longer than wide, wider behind, clothed with fine pubescence and strongly overlapping cephalothorax in front. Dorsal side provided with pale rod like and rounded patches as in text-fig. 1. Ventral side shining reddish brown. Epigyne as in text-fig. 3 and internal genitalia as in text-fig. 4.

Type-specimen: *Holotype* one female, *paratype* ten females and *allotype* five males in spirit.

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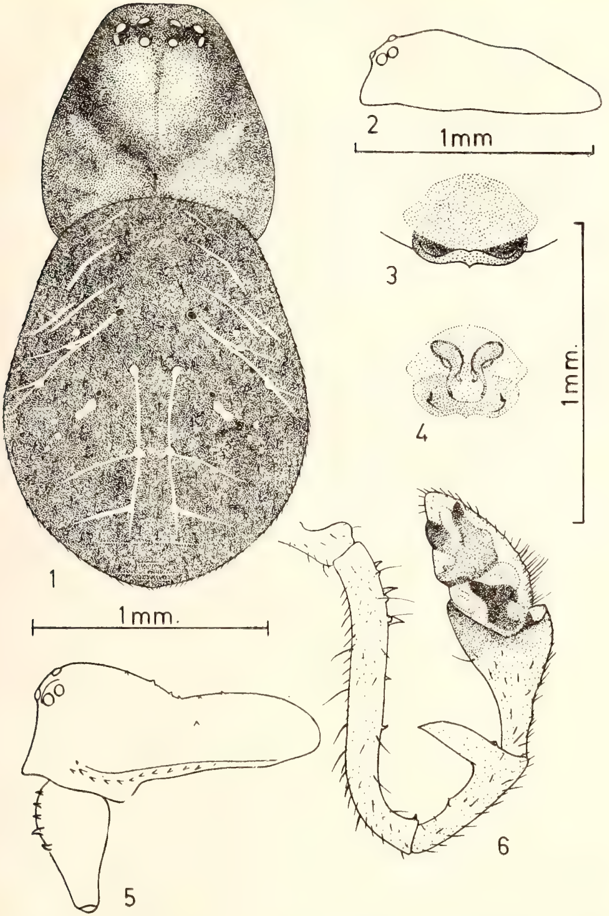
[1] Accepted October 1980.

[2] Zoological Survey of India, Western Regional Station, Poona-411 005. *Present address*: Director, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-700 012.



Figs. 1-6. *Erigone rohtangensis* sp. nov. 1. Dorsal view of female, legs omitted; 2. Lateral view of cephalothorax of female; 3. Epigyne; 4. Internal genitalia; 5. Lateral view of cephalothorax of male; 6. Left palp outer side view.

Type-locality: Rohtang Pass (Alt. 3955 m near Manali, Himachal Pradesh) India, on 12th October 1979 at mid-noon from a snow covered niche below stones.
Coll. *Dr. R. K. Varshney.*

Discussion: This species appears to be closely related to *Erigone dentipalpis* (Wider) but is separated as follows: (i) Abdomen brown but in *E. dentipalpis* abdomen yellow brown. (ii) Male palp also different.

ACKNOWLEDGEMENTS

I am thankful to Dr. R. K. Varshney, for sending the spiders for study. Thanks are also due to Shri P. W. Garde and Shri D. J. Kamble, artists of this station for preparation of illustrations and to Dr. Animesh Bal, for assisting in various ways during the preparation of the manuscript.

REFERENCES

CAPORIACCO, L. (1935): Aracnidi dell' Himalaia e del Karakoram. *Mem. Soc. Entom.* Itali, *13*: 175.

HOLM, A. (1960): The spider fauna of the East African Mountains. *Zool. Bidrag.* Uppsala, *35*: 21-190.

LOCKET, G. H. & MILLIDGE, A. F. (1953): British Spiders. *2*: 307-313.

A NEW *MEMECYLON* L. (MELASTOMATACEAE) FROM TAMIL NADU, INDIA[1]

A. N. HENRY[2]

(With eight text-figures)

Memecylon subramanii sp. nov.

M. hookeri sensu Henry & Subr. in Bull. bot. Surv. India 13: 165. 1971 (1973), non Thwaites 1859.

Memecyloni hookeri Thwaites affinis, differens tamen floribus amplioribus, cymis pedunculatis atqne laxis aggregatis; pedunculis ad 12 cm longis, angulisque anguste alatis.

Allied to *Memecylon hookeri* Thwaites, but differs in: flowers larger, clustered in pedunculate lax cymes; peduncules up to 12 cm long and narrowly winged on angles.

Erect shrubs, 2-4 m tall, sparingly branched: bark grey, flaking off into small pieces: branchlets stout, strongly 4-angled with narrow wings on the angles. Leaves 20-40 × 6.5-14 cm, opposite, sessile or subsessile, lanceate, coriaceous, glabrous, acuminate at apex, cordate at base, penninerved, veins prominent beneath, lateral veins numerous and joining an intramarginal vein; foliar sclereids filiform, mostly non-branching. Flowers 6-7 mm across, clustered in axillary (also in the axils of fallen leaves on old wood), lax pedunculate cymes; peduncles 6-12 cm long, 4-angled with narrow wings on angles; pedicels 6-9 mm long, slender, surrounded at base with an involucre of bracts; calyx 4-5 mm wide, truncate, shallowly 4-lobed, petals 4, each 3-4 mm across, bluish violet, broadly obovate or subrotund, concave, thin, imbricate in bud, easily dropped at anthesis; disc epigynous, shallowly striate with eight radiating ribs; stamens 8, anthers 1-1.5

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[1] Accepted September 1980.

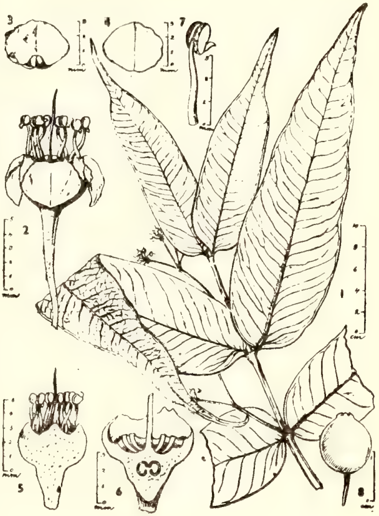
[2] Botanical Survey of India, Coimbatore-641 003.

mm long, connective with a disc-shaped gland; ovary inferior, unilocular with several ovules on a central placenta, style filiform. Berries 9-10 mm across, globose, crowned by calyx-limb, blackish purple when ripe. (Figs. 1-8).

Holotype (*Henry 8407*, CAL) and *isotypes* (*Henry 8407*, MH) were collected from Kannikatti in Tirunelveli district, Tamil Nadu at an altitude of 765 m on 22-4-1972; *paratypes* (*Henry 17365*, MH) were collected from the same locality on 29-8-1963; *paratypes* (*Madras Herbarium—South India Flora No. 14671*, MH) were collected from the same locality on 19-3-1917; and *paratypes* (*Bhargavan 47482*, MH) were collected from Valayar forest near Kannikatti at an altitude of 1000 m on 13-7-1976.

I am pleased to dedicate this species to late Dr. K. Subramanyam, former Director, Botanical Survey of India, Calcutta for his significant contributions to the taxonomy and morphology of Indian Plants.

I am thankful to Dr. Kare Bremer, Botaniska Institutionen, Stockholm for his valuable opinion on the plant, Dr. N. C. Nair, Deputy Director, Botanical Survey of India, Coimbatore for facilities and encouragement, Rev. K. M. Matthew of the Rapinat Herbarium, Tiruchchirappalli for rendering the latin translation, and Dr. T. Ananda Rao, Emeritus Scientist, Botanical Survey of India, Howrah for kindly porviding the foliar sclereid morphology of this species.



Figs. 1-8. *Memecylon subramanii* sp. nov.: 1. Portion of branch; 2. Flower; 3 & 4. Petals; 5. Flower: Petals removed; 6. L.S. of gynoecium; 7. Stamen; 8. Fruit.

OBITUARY

CHARLES McCANN, 1899-1980

(*With a plate*)

Yule Mervyn Charles McCann was born at Castle Rock, Goa Frontier, on 4th December 1899.

Educated at St. Mary's High School, Mazagon, he worked and studied for some time at St. Xavier's College, Bombay, under Fr. E. Blatter, S.J., the eminent botanist. He served as a laboratory assistant and general factotum in the biological laboratory and was curator of the college museum. During this period (1916-1920) he carried out research in systematic botany both independently and as a probationer under Fr. Blatter. Then he left the college and worked with the Bombay City Police for about a year. In 1921 he joined the Bombay Natural History Society as a field collector for the Mammal Survey in the Palni Hills and later in the Indus Delta, and soon became its Assistant Curator.

At that time the Society's staff was working on the construction of the Natural History galleries of the Prince of Wales Museum of Western India and McCann played no small part in the collecting, skinning, modelling and preparation of the group cases which though now sadly jaded and somewhat out of date, were then considered among the finest exhibits of their kind in the world.

The following passage from a published note about himself and his place of birth is very real:

"Some of the grandest tropical forest surrounded the area and the fauna abounded with wildlife, from elephants to flies, so much so that doors had to be closed at sundown for fear of dangerous intruders—even the King Cobra, though rare, occurred in the area. Such an environment seems to have influenced my future as a student of nature!(?) My parents informed me that I was the bane of their existence for I froze on to everything that moved. All attempts at shaping my ends had no avail. From "misdirected" babyhood onwards the "kink" increased out of all proportion (according to some, I was just daft!)"

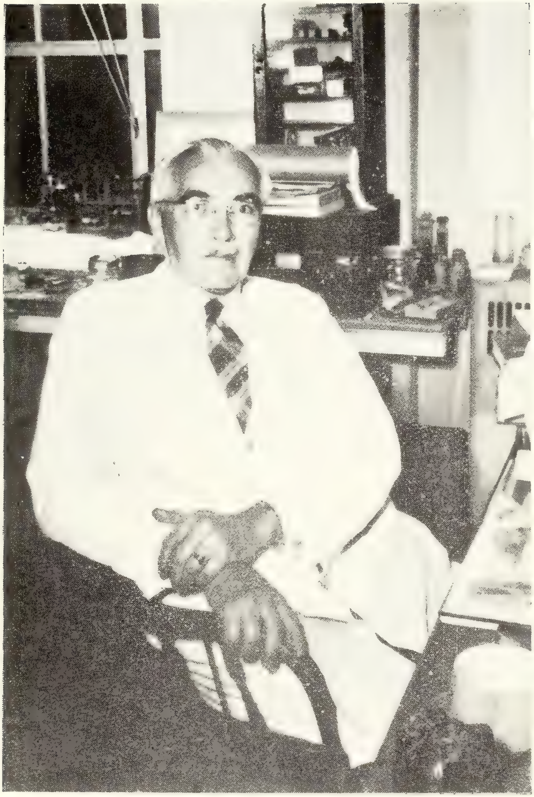
Charles McCann was a boon companion on any natural history trip—irrespective of whether you were chasing tiger or butterflies—one of the great advantages of his company was the apparent delight he took in repairing flat tyres, skinning birds and in fact doing all the donkey work of the trip while at the same time keeping his eyes, ears and hands open for all items of natural history interest.

From 1932 to 1947 he was one of the editors of the Society's journal to which he has contributed perhaps 200 notes and papers covering a most extraordinary range of subjects, from taxonomic botany to bats, birds, snakes, lizards, tortoises, frogs and a variety of insects. A short, but representative list of his publications is appended.

At the time of Independence, the uncertainty of the future for foreigners and Anglo-Indians in India, prompted him to resign from his post and migrate to New Zealand, a step which he regretted as all his letters showed.

When he resigned in 1946, the Executive Committee of the Bombay Natural History Society recorded its appreciation of his services, and the relative minute reads in part:

"The merit of his scientific work is evidenced in his many biological contributions to the journal of the Society. He is one of the outstanding botanists in India and his monograph on Grasses, which he wrote jointly with the late Fr. Blatter and which was published under the aegis of the Imperial Council of



Charles McCann
(1899-1980)

Agricultural Research, will remain for many years the standard work on the subject. Equally outstanding in merit are his various revisions of the genera and species of Indian plants which the Society was privileged to publish. McCann also contributed various authoritative papers on Indian Mammals, Reptiles, and Amphibians. The study of nature was his absorbing passion and his main recreation...His resignation is a great loss to the Society."

He soon found work as Vertebrate Zoologist with the Dominion Museum in Wellington, where he concentrated on the arrangement of birds and mammals and later specialized on the whale and seal collections. After retirement and a spell in hospital he joined the N. Z. Oceanographic Institute, whence also be retired for a second time after some work on deep-sea fishes (*Macruridae*). He has written on the Lizards of New Zealand and some papers for the Japanese Whale Research Institute.

After retirement pecuniary circumstances forced him to work as a garage assistant for sometime, but failing eyesight and other aspects of health made him spend the last few years of his life in physical inactivity until he passed away on 29th November 1980. With McCann's passing we have lost one of the most active and versatile field naturalists that India has produced for a long time, and we extend our sympathies to Mrs. McCann and his children. In memory of his versatility as a naturalist and his invaluable scientific contributions while in India, friends and admirers have enabled the Bombay Natural History Society to institute the Charles McCann Fieldwork Fund which offers financial assistance to those interested in undertaking specific projects of field research. We hope it will give to his name the tribute that it is due.

At the time of his death he had been a fellow of the Linnean Society of London for 51 years.

H.A.

On the Breeding Habits of some *Myriapoda* *26*: 303-4.

A note on the Habits of the Large-scaled Earth Snake (*Silybura macrolepis*) *29*: 1062-3.

Occurrence of the worm-like Batrachian *Ichthyophis* monochrous at Khandala. Poona District. *31*: 1039.

The Study of Plant Life—(3 parts) Vols. *32*: 692-703 (2 plates & 5 text-figures) and *33*: 35-46, 262-278.

Notes on the Flowering of *Strobilanthes callosus* *34*: 264-65.

Notes on some wild species of Aroids *34*: 518-21.

On the Fertilization of the Flowers of the Sausage-Tree (*Kigelia pinnata*) by Bats *35*: 467-71.

Notes on Indian Batrachians (10 plates. 2 text-figures) *36*: 152-80.

Notes on the Flying Fox (*Pteropus giganteus*) *37*: 143-49.

Notes on the Common Land Crab (*Paratelphusa guerini*) of Salsette *39*: 531.

The Flamingo (*Phoenicopterus ruber antiquorum* Temm.) (7 plates) *41*: 21-38.

On the road to Gersoppa and back *41*: 446-452. (With A. R. Hughes).

A Reptile and Amphibian Miscellany. 2 parts. (15 plates 3 text-figures) *41*: 742-64; *42*: 45-64.

Two naturalists visit Karwar. N. Kanara (1 plate) *42*: 602-10.

The Rains come to the Abu Hills. (with a plate) *43*: 641-47.

With BLATTER, REV. E., S. J. PH.D., F.L.S.

Revision of the Flora of the Bombay Presidency —16 parts Vols. *32-36*.

Two new species of Grasses from Panchgani (Satara District) *32*: 357-58.

Some new species of Plants from the Western Ghats. *32*: 733-36.

A New *Ceropegia* from the Western Ghats. *34*: 936.

Another new *Ceropegia* from the Western Ghats *35*: 409.

100 BEAUTIFUL TREES OF INDIA, D. B. Taraporevala Sons & Co. (1959).

MISCELLANEOUS NOTES

1. OBSERVATIONS ON A REMARKABLE ASSOCIATION BETWEEN RHESUS MONKEY (*MACACA MULATTA VILLOSA*) AND THE HIMALAYAN LANGUR (*PRESBYTIS ENTELLUS SCHISTACEUS*) IN THE KUMAUN HIMALAYAS, INDIA

A large troop of langurs and a small one of rhesus monkeys were observed near Hanumangarhi hill, Nainital (in the first week of September 1978) to move together as one group in a remarkable manner. There were 22 langurs of various ages and sizes, while the rhesus monkeys were only eight in number. The troop of langurs consisted of two large males, two groups of eight adult females and younger langurs of different age groups, there being four baby-langurs in the group. The eight rhesus monkeys' group was made up of one large male (the leader), two large females, three smaller females and two baby monkeys.

They lived in a ravine, at a height of about 2000 m situated between two stands of mixed oaks, firs, Cypresses and conifers. To our utter amazement one large female langur was seen moving about on the ground, breast feeding a tiny rhesus baby of a dark brown colour with a short tail. While another older rhesus baby was riding piggy-back on a medium sized male langur.

The two large male langurs took up position, one on each side of the ravine, each on high boulder, as soon as they saw us. The females and younger langurs took to the trees and bounced about from branch to branch. But the larger ones remained on the rocks below with the rhesus monkeys, unperturbed even when we approached as close as fifty metres. The baby rhesus maintained their positions, one on the breast of an adult female langur and the other riding piggy-back on a young male. Four half grown baby langurs accompanied their mothers, who moved about leisurely at the foot of a tall tree.

However, the large male rhesus (very large for the species) ran up the slope and took up guard position on a rock. Thus the whole troop appeared guarded by three sentinels-two on the sides and one up behind the group.

On our approaching still nearer one male sentinel langur gave a sharp guttural note, at which all the langurs (with the two baby rhesus on them) bolted up the trees on the sides of the ravine and bounded from tree to tree. The rhesus monkeys on the other hand moved slowly (but in an alert condition) to the nearest trees, and climbing up about 3 metres above ground, sat watching us closely. The large male rhesus, however, did not move from its sentinal position and grinned at us. The entire action described above took hardly twenty minutes.

On our leaving scene, the rhesus male descended from its high perch and started foraging among the boulders and rocks and tree-roots, as it was doing before we disturbed them. The langurs and rhesus monkeys also came down to the lower branches of the trees, and started feeding on the new fruits, leaves and buds around them.

The amazing feature in our observations was the congenial atmosphere between the two groups of primates of different genera. This close association appeared to be of mutual benefit, veering to commensalism (food sharing), a remarkable sight not observed by the authors in our experience of mammals.

This extremely remarkable co-operation in danger and 'commensalism'; and even in community feeding of babies between two different genera of primates, appears to be a unique phenomenon not hitherto recorded in literature.

KUMAUN UNIVERSITY,
NAINITAL, U.P.,
June 21, 1980.

S. M. DAS
B. D. SHARMA

2. OBSERVATIONS ON BIRTH OF A MUSK DEER FAWN

A musk deer was born at the Musk Deer Farm, Kufri (Simla) on 19th June 1979.

The mother had been captured as a young fawn in Mashnoo forest of Sarahan Forest Range in Kotgarh Forest Division, Himachal Pradesh. It was said to have strayed into a flock of grazing sheep. The shepherd caught the fawn and brought it to Simla on 3-7-1977. It is believed that the fawn was about 15 days old at the time of capture. It was bottle fed on cow's milk for about 4 months and then gradually weaned to regular feed.

Mating was noticed during December 1978, when the mother was 1½ years old. The fawn was born to it in June 1979 (17-6-1979) at the age of 2 years. The female was observed to be dull in her movements and reluctant to take her normal feed for 3 days before fawning. The mother had mated with a young male deer of about 1½ years of age. The male deer was also from the local stock, captured on 4-8-1977 in Throach forests of Chopal Forest Division, Himachal Pradesh.

The animal keeper saw the fawn hidden under the grass bedding at 10 O'clock on the morning of 17-6-1979. The mother as usual had left the night shed for morning feeding in the open enclosure. Perhaps the fawn was born sometimes during the night as the fawn was reported to be dry and clean. The enclosure was also clean.

The fawn was shy and alert but made no attempts to run away.

The fawn was grey in colour having a soft, furry body with long hair. It had a whitish-light golden streak about 3.5 cm on the back, running from shoulder to the back and other thin white streaks on either side running parallel to it. Whitish under the throat extending to the belly. In proportion to the body it appeared to have comparatively long ears and looked more like a 'Mouse deer' with long ears.

Some measurements of the fawn taken on 19-6-1979 (after 54 hours of birth) were as under:

Total weight :	1 kg
Length: (total length tip of tail to tip of nose)	37 cm
Height at shoulder:	25 cm
Girth at Chest:	24 cm

The mother was observed suckling the fawn twice during the period 9 a.m. to 5 p.m. The fawn was also fed once a day artificially with bottle milk.

ASST. CONSERVATOR OF FORESTS,
WILD LIFE CIRCLE,
TALLAND, SIMLA, H.P.,
February 20, 1980.

M. S. JAIN

3. OCCURRENCE OF THE LARGE BROWN FLYING SQUIRREL AND MOUSE DEER NEAR UDAIPUR, RAJASTHAN

The Large Brown Flying Squirrel (*Petaurista petaurista philippensis*) and the Mouse Deer (*Tragulus meminna*) have not been reported from Rajasthan so far (Ellerman & Morrison-Scott 1951, Prater 1980). Recently I saw the large Brown Flying Squirrel and the Mouse Deer in the teak dominated, dry deciduous forests of Dharyavad (*c* 24° 4′ N, 74° 24′E) near Udaipur.

I have seen the Flying Squirrels in the jungles of Jharol, Gogunda and Kotra Tehsils of Udaipur also. In the early thirties my father shot two Mouse deer in the jungles of Jharol (*c* 24°N, 73°E). The local name of Mouse deer is 'Phonkra'. The forest in these areas are Tropical dry deciduous Miscellaneous Forests.

41, PANCHWATI,
UDAIPUR-313 001,
RAJASTHAN,
October 9, 1980.

RAZA H. TEHSIN

REFERENCES

ELLERMAN, J. R. & MORRISON-SCOTT, T. C. S. (1951): A Checklist of Palaearctic and Indian Mammals 1758-1946. British Museum, London.

PRATER, S. H. (1980): The Book of Indian Animals. Bombay Natural History Society, Bombay. (Reprinted, 4th edition.)

4. OBSERVATIONS ON THE EPIDEMIOLOGY OF HAIRY-FOOTED GERBIL, *GERBILLUS GLEADOWI* MURRAY, IN THE INDIAN DESERT

According to Prakash (1967), *G. gleadowi* is distributed in the arid belt of Jaisalmer, Gadra Road, Jodhpur and is more common in Gadra Road sector. Some more information has been added to literature by Prakash (1975) on this rodent and in this communication, we are reporting our observations on the rodent when it invaded the *kharif* crop fields in enormous numbers.

An explosion of the population of this rodent occurred at the onset of the monsoon in 1971, in Sanchore tehsil of Jalore district, whole of Barmer district, parts of Shergarh and Phalodi tehsils of Jodhpur district and Pokaran tehsil of Jaisalmer district when the following investigations/observations were made on this rodent.

The local name of the rodent is *chotti ratod* which aptly signifies its size, nocturnal habits, pinkish colour and cutting habits on field crops. Enquiries made from very old local people in several villages of Barmer district, revealed that an epidemic similar to the one in 1971 had occurred some sixty years earlier when the desert area had received abnormal rainfall and vegetation in luxuriant form appeared and crops yielded bumper harvests. Rao (1960) stated that *ratod* (*Tatera indica*) was known to have increased enormously in numbers in the past as for instance in 1893-94 in Marwar, (present Jodhpur division) so as to cause great destruction to crops. This shows that epidemics of rodents in Rajasthan are not uncommon.

The burrows of this rodent are generally found in loose sandy soil, flat or undulating or sand dune habitats; the openings of burrows are usually plugged with sand. Sometimes, the burrows were also noted in compact sandy soil. The burrows are generally associated with hummocks of perennial desert bushes such as *Calotropis procera, Zizyphus nummularia, Crotalaria burhia, Aerua tomentosa, Lassurus sindicus, Capparis decidua* etc. but during the monsoon of 1971 they also shifted their habitat to *kharif* cultivated area and made burrows there. The burrows are simple and have one to three openings as reported by Prakash (1967) but sometimes more than three openings (not plugged with sand) were also observed. Usually the burrow is about 60 to 90 cm deep having a main chamber in which green parts of stems and leaves of *bajra* (*Pennisetum typhoideum* Rich) and other kharif crop plants were stored presumably as food. When they made burrows in the crop areas they made *Kharif* crops special targets at night causing extensive damage.

Epidemic and observations on ecology

The explosion of population of the hairy footed gerbil was mostly confined to Barmer district and Sanchore tehsil (Jalore district), though adjoining areas were also infested heavily in Jaisalmer and Pokaran tehsils (Jaisalmer district) and Shergarh tehsil (Jodhpur district) of Rajasthan.

There was poor rainfall in 1965 and 1966 and from 1967 to 1969 the entire district suffered from severe drought consecutively for 3 years there by greatly depleting the fauna and flora in the desert. The year 1970 was, however, a year of prosperity because of widespread rains received at well spaced intervals during monsoon all over Barmer district. The annual rainfall during 1970 recorded at Barmer, Gadra Road, Chohtan, Pachpadra, Balotra and Siwana was 198.1, 202.5, 150.12, 149.3, 245.9, 210.3 mm respectively. Consequently, there was abundant vegetation and the cultivators raised bumber crops of *bajra, guar* (*Cymmopsis tetragonoloba*), *mung* (*Phaseolus radiatus*), *moth* (*Phaseolus aconitifolius*) and *til* (*Sesamum indicum*). It appears that the favourable ecological conditions induced heavy reproduction and multiplication of *Gerbillus gleadowi* in the desert area although the population did not reach a menacing level till the harvest and therefore obviously escaped the notice of farmers. During winter and next spring, sufficient food for them like seeds of grasses and herbs and fruits of *Citrullus colocynthis* were available. In fact, the luxuriant growth of *Citrullus colocynthis* having large number of fruits helped in its multiplication and survival during winter of 1970-71. During May and June 1971, Chohtan and Pachpadra tehsils of Barmer district received unusually heavy premonsoon showers. Thus conditions became most suitable for sowing of crops which were sown early. There was plenty of ephemeral vegetation after early rains. The ecological conditions for multiplication of rats also became suitable obviously due to their high population and availability of ample food. Heavy multiplication of this species occurred in the whole Barmer district which ultimately resulted in severe damage to seedlings of young crops of *bajra*, *guar* and *pulses*. In some areas repeated resowing had to be done as the rodents and their young ones devoured the seeds from soil sown by the farmers. Outbreak in the population of this gerbil occurred in 83,333 hectares in the seven Panchayat Samities of Chohtan, Dhorimana, Barmer, Baitu, Sheo, Sindhari and Balotra involving 650 villages. Government of Rajasthan declared a rat epidemic of this species in Barmer district as on 21st July, 1971 for a period of one month. The annual rainfall during 1971 recorded at Barmer, Gadra Road, Chohtan, Pachpadra and Balotra was 198.1, 205.0, 163.00, 156.2, 258.1 mm respectively.

The gerbil is nocturnal in habit and active during the whole night. It goes back to its burrow just a little before dawn. Extensive damage was caused to the *kharif* crops at various stages, right from the sowing stage. It picked up seeds from the soil, causing very poor germination or no germination at all. The young seedlings were devoured completely. Even when the *bajra* plants were 25-30 cm high, leaves and shoots were cut near the root. Young tillers were damaged and eaten at the tillering stage of *bajra* reducing the yield of the crop considerably. It is interesting to note that it is able to climb on *bajra* plants nearing harvest. At the ripening stage of the *kharif* crop, the ears of *bajra*, pods of *guar*, *mung* and *moth* and fruits of til were extensively damaged.

During survey of the infested fields in August, cultivators reported that in some fields in Chohtan and Dhorimana areas, resowing of *bajra* had to be done 4 to 5 times due to heavy damage caused to young seedlings and picking of seeds from the soil by this rodent.

During July-August, 1971, very heavy populations of this species was reported around Shergarh town though earlier very low population was present there.

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REFERENCES

PRAKASH, ISHWAR (1963): Zoogeography and evolution of the mammalian fauna of Rajasthan desert of India. *Mammalia*, 27: 342-351.

———— (1967): Some observations on the hairy footed Gerbille, *Gerbillus gleadowi*, Murray, in the Rajasthan desert. *J. Bombay nat. Hist. Soc.* *63*(2): 431-434.

————AND GHOSH, P. K. (1975): Rodents in Desert Environments. *Monographiae Biologicae*. Vol. 28 Dr. W. Junk b.v. Publishers. The Hague 1975 (Prakash, Ishwar 1975. The population ecology of the rodents of the Rajasthan desert, India. pp. 75-116).

RAO, Y. RAMCHANDRA (1960): The Desert in India. Monograph No. 21. I.C.A.R., New Delhi, pp. 721.

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5. OCCURRENCE OF *BANDICOTA BENGALENSIS* AND *VANDELEURIA OLERACEA* IN WESTERN RAJASTHAN

During the monthly trapping programme for ecological studies on *Rattus meltada pallidior* at Erinpura, Pali district, two species of rodents were collected which are hitherto not reported from this region.

Bandicota bengalensis kok (Gray): Lesser Bandicoot Rat.

Material examined: 3 ♂ and 3 ♀ from Bisalpur, 4 km east of Erinpura, Pali district.

Measurements: Head & body ♂ 171.50 ± 1.50, ♀ 158.0 ± 2.00; Tail ♂ 127.0 ± 1.0, ♀ 139.00 ± 1.00; Hind foot ♂ 33.5 ± 1.50, ♀ 34.5 ± 0.49; and Ear ♂ 22.5 ± 1.5, ♀ 23.0 ± 1.04.

B. bengalensis is being reported for the first time from western Rajasthan. The specimens were collected from scrub grassland and crop fields. Wroughton (1908) had described two new species of *Gunomys* (*Bandicota*), namely, *G. sindicus* (Sind specimens) and *G. lordi* (Konkan specimens) which are now treated as synonyms of *B. b. kok* (Ellerman 1961). According to Wroughton (loc. cit.) *G. kok* could be identified by its finer and softer fur from the two others which have harsh fur, and in possessing smaller (8 mm or less) upper molars (8.3 mm in *G. sindicus* and *G. lordi*. A comparison of the body and molar measurements of specimens of *B. b. kok* (*sindicus*), collected from Pithoro and Umarkot, Sind, *B. b. kok* (*lordi*), collected from Umarkot, Sind; as detailed by Ellerman (1961, 820-821) and that of the present collection from Bisalpur (Pali district), reveals that the Rajasthan specimens are smaller in body size than *sindicus* from Sind but compare well with *lordi*, except in tail measurement which is fairly shorter. It resembles *Gunomys kok*, as described by Wroughton in having finer and softer fur. As regards the upper molar length, a character used by Wroughton in splitting species, the molar length (7.5 mm) of Rajasthan material is shorter than that of '*sindicus*' but it is comparable to that of '*lordi*'. Thus in body as well as cranial characters Rajasthan specimens are closer to *B. b. kok* (*lordi*). This comparison, which indicates overlapping of measurements of Wroughton's species, justifies the decision taken by Ellerman (1961) in lumping the species described by Wroughton (1908) under *B. b. kok*.

Vandeleuria oleracea spadicea Ryley. The Long-tailed Tree Mouse.

Material examined: 2♂♂, from Bisalpur, 4 km east of Erinpura, Pali district, western Rajasthan.

The two specimens were collected from thickets of *Prosopis juliflora, Acacia nilotica cupreciformis, Zizyphus nummularia* and *Mimosa hamata*. The Long-tailed tree mouse, *V. o. spadicea* has been recorded from Gujarat and the present report extends its range further north.

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REFERENCES

ELLERMAN, J. R. (1961): The fauna of India including Pakistan, Burma and Ceylon. 3 (P + 1 & 2) Manager of Publ., New Delhi.

WROUGHTON, R. C. (1908): Notes on the classification of the Bandicoots. *J. Bombay nat. Hist. Soc. 18* (4): 736-752.

6. IMPACT OF CYCLONE ON THE RODENT POPULATION IN ANDHRA PRADESH

It is of interest to know about the survival and changes in number of rodents during catastrophes like cyclones. Hence a detailed (Post cyclone) survey of rodent pests in 153 hectares was conducted in Bapatla taluk of Andhra Pradesh immediately after the 1977 severe cyclonic storm which had the intensity of a hurricane and data were compared with pre-cyclone survey made in February, 1977. The areas surveyed were around four villages, Adivi, Ganapavaram, Karlapalem and Maruproluvandlapalem in addition to Bapatla. In these surveys the burrows of different species of rodents were identified and counted by live burrow counting (Barnett, S. A. and Prakash, I., 1975, Rodents of economic importance in India, Arnold Heineman, New Delhi). Some live burrows were excavated and the number, the litter size and breeding state of the individuals were recorded.

The infestation of rodents was maximum in paddy (*Oryza sativa*) fields followed by bajra (*Pennisetum americana*) and ragi (*Eleucine coracana*). The number of burrows of *Mus* species (*Mus booduga* and *Mus platythrix*) was more followed by *Bandicota bengalensis* and *Rattus rattus* in the agroecosystems (Table 1). The post cyclonic survey indicated an enhancement in the number of burrows. The litter size in the post cyclonic rodent population was also more ($P<0.001$ in *B. bengalensis*. $P<0.05$ in embryo count and $P<0.001$

TABLE 1

DISTRIBUTION OF RODENT BURROWS IN DIFFERENT CROPS AROUND BAPATLA DURING PRE-AND POST-CYCLONE PERIODS

Name of the crop	No. of hectares	Period	Total No. of burrows	Burrows per hectare			
				*Mus** sp.	*B. bengalensis*	*R. rattus*	*T. indica*
Paddy	50	Pre cyclonic	375	4.0	2.0	1.5	—
(*Oryza sativa*)		Post cyclonic	750	7.0	5.0	3.0	—
Bajra	25	Pre cyclonic	112	3.0	1.0	0.5	—
(*Pennisetum americana*)		Post cyclonic	180	5.4	1.0	0.8	—
Ragi	28	Pre cyclonic	84	0.5	2.0	0.5	—
(*Eleucine coracana*)		Post cyclonic	70	0.5	1.0	1.0	—
Uncultivated fields	50	Pre cyclonic	10	—	—	—	0.2
		Post cyclonic	40	0.5	—	—	0.3

* *Mus booduga* and *Mus Platythrix.*

TABLE 2

DISTRIBUTION OF LITTER SIZE AMONG DIFFERENT RODENT SPECIES AROUND BAPATALA DURING PRE- AND POST-CYCLONE PERIODS

Rodent species	Sample size	Embryo count				Field collection			
		Pre cyclonic		Post cyclonic		Pre cyclonic		Post cyclonic	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bandicota bengalensis	15	2-5	2.8 ±1.5	1-7	4.5 ±2.0	1-4	1.50 ±1.0	1-4	2.5 ±0.75
Mus sp.	10	1-8	3.5 ±1.5	2-10	5.5 ±2.5	1-5	1.5 ±0.75	2-5	3.5 ±1.0
Rattus rattus	10	1-6	2.5 ±1.2	1-7	2.5 ±1.0	—	—	—	—
Tatera indica	5	1-5	2.5 ±1.0	1-5	3.5 ±1.0	—	—	—	—

* *Mus booduga and Mus Platythrix.*

in the field collections of *Mus* species). It was not significant statistically in *Tatera indica* and *R. rattus* (Table 2). In both the periods *Mus* had more number of litters followed by *B. bengalensis* and *R. rattus* in the fields. *T. indica* was seen only in unirrigated dry fields at all times.

The enhancement of rodent numbers may be due to the greater availability of good quality food from the crops scattered by the cyclone. Similar vegetation conditions during both the surveys ruled out the effect of season on the rodent number. The reduced competition due to flooding of burrows of field rodents may be another responsible factor. Migration by swimming may also account for the increase in the live burrows of rodents in the survey areas. However it is unlikely to be a factor in the present case since a vast stretch of land was flooded. The higher incidence of *Mus* after the cyclone may be due to their habitat diversity in both dry and wet areas.

In the absence of any other factor as responsible for the increased rodent numbers, the food destroyed by the cyclonic water, and rendered unfit for human consumption, might have triggered the increased reproduction, thereby, resulting in high numbers.

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7. SOME NOTES ON AGE OF SEXUAL MATURITY OF SEVEN SPECIES OF INDIAN WILD MAMMALS IN CAPTIVITY

Perusal of the available literature revealed that there are not many reports on the age of sexual maturity of different Indian Wild mammals. In this note an attempt is made to present some notes on the age of sexual maturity of seven species of Indian Wild mammals observed at Nandankanan Biological Park, Orissa.

OBSERVATIONS AND DISCUSSION

TIGER (*Panthera tigris*)

A tigress born in the Park on 14-12-1972 was kept along with a tiger born here on 22-6-1973 from 15-7-1974.

Mating of this pair of tigers was observed for the first time from 6-12-1975 to 7-12-1975 and subsequently during the following periods: 4-1-1976 to 6-1-1976, 1-2-1976 to 4-2-1976, 24-3-1976 to 26-3-1976, 7-5-1976 to 10-5-1976, 26-6-1976 to 30-6-1976, 29-8-1976 to 4-9-1976 and 9-1-1977 to 14-1-1977 resulting in the birth of three cubs on 22-4-1977.

These observations suggest that while the tigress came to her first oestrus at the age of

TABLE

Sl. No.	Date of birth (Name of the specimen)	Dates of first mating observed (Age at which first oestrus observed)	Date of successful mating with conception	Date of first parturition	Age of sexual maturity (Age at which littered for the first time)
1	2	3	4	5	6
1.	20-1-1973 (LATA)	6-3-1975 (2 years, 1 month and 15 days)	29-3-1975 to 1-4-1975	7-7-1975	2 years, 2 months and 10 days or say 2 years and 2 months (2 years, 5 months and 18 days)
2.	23-7-1973 (SHANTI)	17-10-1975 to 22-10-1975 (2 years, 2 months and 25 days)	29-1-1977 to 2-2-1977	8-5-1977	3 years, 6 months and 7 days or say 3 years and 6 months (3 years, 9 months and 16 days)
3.	2-8-1973 (BASANTI)	26-1-1976 to 29-1-1976 (2 years, 5 months and 25 days)	5-12-1977 to 9-12-1977	14-3-1978	4 years, 4 months and 4 days or say 4 years and 4 months (4 years, 7 months and 13 days)
4.	23-2-1975 (TORU)	Not recorded	Not recorded	11-2-1978	— (2 years, 11 months and 20 days)

2 years 11 months and 23 days or say about 3 years, the male reached his sexual maturity at the age of 3 years 6 months and 19 days or say about 3 years and 7 months.

According to Acharjyo and Misra (1975) the first signs of sexual maturity in a tigress appeared at the age of about 3 years but a tiger did not reach his sexual maturity at least one week before he reached the age of 4 years. Chaturvedi (1970) states that the first cubbing of a tigress takes place at about the age of four and a tiger is full grown in about 5 years. A tigress became sexually mature soon after passing the age of 3½ years whereas a tiger became sexually mature at least 15 days before he reached the age of 4 years (Crandall 1965). Prater (1971) states that lions and tigers take from three to five years to became fully adult but males and females are capable of breeding soon after, or even before, they are three years old. Little has been published regarding the age at which tigers reach sexual maturity (Schaller 1972). At the Whipsnade Zoo a female is said to have produced a litter at the age of 2 years (Pocock 1939). Abramov (1962) and Novikov (1962) have given the age of sexual maturity in this species as 4 years. Sankhala (1967) states that the tiger cubs mature at an age between 3½ and 6 years.

LEOPARD OR PANTHER (*Panthera pardus*)

The details of age of sexual maturity observed in four female leopards are given in the Table. They were living with sexually matured males from the age of six to twelve months.

A study of this table reveals that while the first signs of oestrus appeared at the age of about 2 years and 2 months to about 2 years and 6 months, they littered for the first time at the age of about 2 years and 6 months to about 4 years and 7 months. They were capable of reproducing at the age of about 2 years and 2 months to about 4 years and 4 months.

Five female leopards of the Delhi Zoological Park came into oestrus for the first time at the age of 1 year and 8 months to 3 years and 10 months (Desai 1975). He further states that six female leopards littered for the first time at the age of 2 years and 3 months to 4 years and 2 months. Prater (loc. cit.) states that leopards are generally full grown in one and half to three years.

GOLDEN CAT (*Felis temmincki*)

One female golden cat born in the Park on 2-3-1972 littered for the first time in her life on 9-4-1974 at the age of 2 years, 1 month and 8 days or say about 2 years and 1 month. This was living with an adult male throughout this period.

The smaller cats are almost adult when a year old (Prater loc. cit.). Females of most species of *Felis* attain puberty at the age of 12 to 15 months (Walker *et al.* 1964).

JUNGLE CAT (*Felis chaus*)

A male Jungle cat born in the Park on 7-11-1975 was kept along with a full grown adult female of the same species from the age of about six months. The female gave birth to a litter of five kittens on 10-11-1977 when the male was 2 years and 4 days old. Taking the gestation period as above 2 months (Asdell 1964) the age of sexual maturity of the male can be said as 1 year, 10 months and 4 days or say 1 year and 10 months.

The smaller cats are almost adult when a year old (Prater, loc. cit.). Females of most species of *Felis* attain puberty at the age of 12 to 15 moths (Walker *et. al.*, loc. cit.)

COMMON PALM CIVET OR TODDY CAT (*Paradoxurus hermaproditus*)

One female of this species born in the Park on 30-4-1975 was living with adult males from the age of about four months. Mating of this female with an adult male was observed for the first time from 23-2-1976 to 28-2-1976 resulting in the birth of a litter of three young on 1-5-1976. The observations suggest that the female became sexually mature at the age of 9 months and 24 days or say 10 months.

The age at which the civets became fully adult is not known (Prater, loc. cit.). Acharjyo and Misra (1975) have given the age of sexual maturity of one male Common Palm Civet as 11 months.

BLACKBUCK OR INDIAN ANTELOPE (*Antilope cervicapra*)

One blackbuck doe born on 26-2-1975 has given birth to a female young for the first time on 16-4-1977 at the age of 2 years, 1 month and 22 days. This was living with adult males throughout this period. Taking the gestation period as 6 months (Asdell, loc. cit.) the age of sexual maturity of this female can be said as 1 year 7 months and 22 days or say 1 year and 8 months.

The age of sexual maturity of two females of this species is given as 1 year and 7 months and 1 year and 11 months respectively (Acharjyo and Misra 1973). From his observations of two yearling does of this species Schaller (loc. cit.) states that possibly they did not bear their first young until two and a half to three years old. According to Taibel (1937) the captive does of this species reach sexual maturity at six months of age and one female had her first young at the age of about fourteen months.

CHITAL OF SPOTTED DEER (*Axis axis*)

One female of this species born here on 20-1-1975 gave birth to a dead male fawn for the first time on 27-2-1977 at the age of 2 years 1 month and 8 days. This was living with an adult male throughout the period of observation. Taking the gestation period as 7 to $7\frac{1}{2}$ months (Asdell, loc. cit.) the age of sexual maturity of this female can be said to be about 1 year and 6 months.

Chital reach maturity at the age of two years (Prater, loc. cit.). Many Chital appear to conceive when they are fourteen to seventeen months old (Schaller, loc. cit). He further states that a Chital doe with an estimated age of 23 to 24 months carried full-term foetus when killed by a tiger at Corbett Park. One doe in Hawaii was pregnant when killed at an estimated age of eight to ten months (Nichols 1960).

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REFERENCES

ABRAMOV, V. (1962): Cited by Schaller, George B. (1972).

ACHARJYO, L. N. AND MISRA, R. (1973): A note on age of sexual maturity of two species of antelopes in captivity, *J. Bombay nat. Hist. Soc.* 70 (2): 378.

——— AND ——— (1975): Age of sexual maturity of two species of Wild carnivores in captivity. *J. Bombay nat. Hist. Soc.* 72(1): 196-197.

ASDELL, S. A. (1964): Patterns of mammalian Reproduction. Second Edition, Cornell University Press, Ithaca, New York, pp. 490-617.

CHATURVEDI, M. D. (1970): The Felines. National Book Trust, India, New Delhi, p. 28.

CRANDALL, LEE S. (1965): The management of Wild Mammals in captivity. The University of Chicago Press, Chicago and London, p. 387.

DESAI, J. H. (1975): Observations on the Reproductive Biology and early postnatal Development of the Panther, *Panthera pardus* L., in captivity. *J. Bombay nat. Hist. Soc.* 72(2): 293-304.

NICHOLS, L. (1960): Cited by Schaller, George B. (1972).

NOVIKOV, G. (1962): Cited by Schaller, George B. (1972).

POCOCK, R. (1939): Cited by Schaller, George B. (1972).

PRATER, S. H. (1971): The Book of Indian Animals. Third (Revised) Edition, Bombay Natural History Society, Bombay.

SANKHALA, K. S. (1967): Cited by Desai, J. H. (1975).

SCHALLER, GEORGE B. (1972): The Deer and the Tiger. The University of Chicago Press, Chicago and London.

TAIBEL, A. (1937): Cited by Schaller, George B. (1972).

WALKER, ERNEST P. *et. al* (1964): Mammals of the World, Vol. II. The John Hopkins Press, Baltimore, p. 1274.

8. TWELVE YEARS OLD COMMON TEAL (*ANAS CRECCA*)

While analysing the ringing data of the Bird Migration programme of the Bombay Natural History Society during the past twenty years, I came across an interesting longevity record of the Common Teal (C-2871).

The bird whose sex was recorded as a female, was netted and ringed by the Society's field staff on 23rd October, 1966 at Bharatpur, Rajasthan (27°15′N, 77°30′E). It was later shot by Major Sardar Amanullah Khan of Lahore (30°35′N, 74′20°E) on 1st December, 1978 on the bank of river Ravi about sixteen miles from Lahore (Pakistan).

This recovery is the longest survival record (12 Years, 1 Month and 13 Days) of the species in India, though *The Ring* (Vol. VII No. 76/1973-3) published a record of 13 years and 6 months.

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9. THE CRAB PLOVER (*DROMAS ARDEOLA*) IN KERALA

The Crab Plover does not appear to have been recorded in Kerala at any time and is not mentioned in Sálim Ali's BIRDS OF KERALA (Oxford, 1969).

On 11 February, 1979, we were at Muthalappoozhi, Perumathura, 29 km north of Trivandrum, where the backwaters (Kadhinamkulam and the southern stretches of the Paravoor Kayal) are linked with the Arabian Sea. In summer a sandbar forms across the channel, but this year it had not been formed even by the 8th of April.

Here the first bird to catch our eye was a solitary Crab Plover resting on the damp sand close to the surf, with the ridge of dry sand above giving it excellent cover from people moving about on the narrow strip of land between the beach and the backwaters. Between 8.20 and 11.10 a.m. we never lost sight of the bird.

Most of the time it spent resting quietly, often sitting on its tarsi or squatting with its breast and belly pressed to the sand. Although crabs were numerous and often ran right up to the bird, it never attempted to catch them.

It was a juvenile, with dull black only on the mantle and back. The lower edge of the closed wing had an inconspicuous black margin. The crown, sides of the head and the hindneck were streaked lightly with grey. The wing appeared grey when closed, but in flight brown, with the forewing grey and a discontinuous grey wing-bar below it, and a curved band of grey just above the base of the primaries. The stout bill was black except near the tip where the inner edges of the mandibles appeared to be pale brownish. The legs were bluish, and the hind claw was prominent.

The bird was sluggish and at first permitted close approach. It never uttered any call although we put it to flight three times. When alert and suspicious, it stood erect and had an ungainly look. It stalked rather than walked, and never ran even when we walked fast towards it. V.K.S. went on the 23rd February to secure some photographs and found the bird resting amidst a flock of gulls. We went again on the 8th of April but found no signs of the bird.

KERALA NATURAL HISTORY SOCIETY,
TRIVANDRUM, KERALA,
April 21, 1979.

K. K. NEELAKANTAN
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V. K. SURESHKUMAR

10. NOCTURNAL ACTIVITY OF THE TURNSTONE (*ARENARIA INTERPRES*) ON SOUTH SENTINEL (ANDAMAN ISLANDS)

In spring 1973 and 1974, while studying the behavioural ecology of the robber crab (*Birgus latro*) on South Sentinel, a small coral island not inhabited by man, we used to survey the beach in front of our tents almost every night and normally spent several hours to record possible nocturnal activity of the robber and other crabs (For topographical and habitat data on South Sentinel *see* Altevogt and Davis 1975).

It was during these night watches in March 1974 that apart from ghost crabs (*Ocypode* *ceratophthalmus*) foraging at the water line a number of bird waders struck us by their very active nocturnal habits. They would run up and down and to and fro on the sloping coral sand beach by leaps and darts as if chasing quickly moving objects. In the dim moonlight we could not identify the birds, and we are not used to shooting them for identification, either.

Luckily, we entered a new moon phase with clouds and really pitch dark conditions so that only our electric torchlights would enable us to find our ways on the beach. Scanning the water's edge with our torches showed the familiar ghost crabs of all sizes in rapid pursuit of their prey (partly species companions of the smaller size classes), but also a good number of the wading birds we had encountered during the better lit nights before. If caught by the beam of our strong torches they would instantly "freeze" and remain motionless until "released". Immediately after switching off the light it was easy to seize such birds by hand, and one night in early March 1974 we could really stuff our pockets with these birds for photographic recording the next morning. There was not much struggling while the birds were in our pockets, and by daylight, too, they remained quite undistressed in our hand.

Identification and the photographic record showed these birds to be turnstones, *Arenaria interpres interpres* (Linnaeus) which have been recorded from "many islands in the Andamans and Nicobars, the last on 29th April in almost full breeding plumage.... Butler found them still abundant in May at Port Blair and again in the Nicobars in September" (Abdulali 1964, p. 518, who also reports on two specimens from South Sentinel in the collections of the Bombay Natural History Society, Abdulali 1970). In the time between May and September as is well known, these migratory birds perform enormous flights to the far North of the Old World covering 850 km in 25 hours. They belong to the birds with the northernmost breeding record (Ringleben 1969).

Judging from our knowledge of the beach fauna on our isle and its habitat qualities we feel fairly safe in stating that the turnstones' prey consisted mainly of *Ocypode ceratophthalmus* of the smaller size ranges. The adult specimens on this undisturbed island reach a considerable body size (upto 6 cm carapace width) which makes them hardly a suitable catch for the rather small birds' beaks. This was also suggested by the darting movements of the birds visible in the semi-dark moonlit nights. Occasionally also a Talitrid amphipod may have been caught though we cannot imagine that this can successively be achieved routinely. There were no other faunal beach elements of a somewhat quick locomotion type so that the above suggestion seems plausible. Moreover, the birds' name giving gesture could not be performed on our part of the beach as the fine coral sand did not offer stones of turnable size classes.

As we have not come across any reports of such nocturnal activity in turnstones, apart from simple resting on the beach by roaming birds en route, we would invite readers to pay attenion to and report on this interesting phenomenon.

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REFERENCES

ABDULALI, H. (1964): The Birds of the Andaman and Nicobar Islands. *J. Bombay nat. Hist. Soc. 61*: 483-571.

——————— (1970): A catalogue of the birds in the collection of the Bombay Natural History Society-6. *J. Bombay nat. Hist. Soc. 67*: 51-56.

ALTEVOGT, R. AND DAVIS, T. A. (1975): *Birgus latro*, India's monstrous crab. A study and an appeal. *Bull. Dept. Marine Sciences, Univ. of Cochin.* 7: 11-23.

RINGLEBEN, H. (1969): Unterfamilie Steinwälzer. In: GRZIMEKS Tierleben *8*: 183-184.

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11. OCCURRENCE OF THE BLACKWINGED STILT (*HIMANTOPUS HIMANTOPUS*) IN KERALA

Late in the evening on 18-ii-1979 one of us (VKS) spotted a single Stilt in the waterlogged paddy fields near the Agricultural College, Vellayini. The next day we went to the place at 5.15 p.m. and, in the course of an hour, came across nine Stilts. Of these 2 had brownish backs and looked much paler than the others. All the jet black birds had a black patch extending from in front of the eye to the nape, rather like the blinkers of a carthorse. The only pale bird that we could examine closely through our binoculars had smoky-brown on the sides of the head and over the nape. Without an exception, all had greyish hindnecks (from nape to mantle). Evidently they were all of the nominate form. Could they have been juveniles assuming the summer plumage?

The HANDBOOK (Vol. 2, 1969, page 329) says, "Not recorded in Kerala", and the bird is not included in Sálim Ali's BIRDS OF KERALA (1969).

KERALA NATURAL HISTORY SOCIETY,
TRIVANDRUM, KERALA,
February 25, 1979.

K. K. NEELAKANTAN
V. K. SURESHKUMAR

12. OCCURRENCE OF THE WOODCOCK *(SCOLOPAX RUSTICOLA)* AT LOW ALTITUDES

The woodcock's winter migration has been an enigma. It is said to fly non-stop from the Himalayas to the Nilgiris and associated hills in the south, and back again, not stopping in the lowlying area enroute.

On 3-iii-79 while driving through the Mudumalai Wildlife Sanctuary, we observed a sambar kill (the work of wild dogs) on the bed of a jungle stream, a tributary of the Moyar river. We stopped our vehicle and approached the stream on foot. It was 10 a.m. I was in the lead and walking along the stream margin when I put up a woodcock which took off and flew across the stream, which was quite open, and alighted on the ground near a small thicket and ran into it in typical woodcock fashion. I know a woodcock when I see one, having taken part in woodcock beats on the Nilgiri upper plateau (2000 m). To make sure I summoned my father, an experienced woodcock shot, and while he watched I crossed the stream and beat the woodcock out of cover. We both watched the bird as it flew away, and it was unmistakably a woodcock.

The elevation of the area is around 900 m, and it is only 15 to 20 km from the upper plateau of the Nilgiris as the crow flies (or rather as the woodcock flies). Its flight did not show any signs of injury. We looked around in the immediate vicinity for the tell tale marks woodcocks leave—the honey-comb patterned probe marks left by the bird's bill in mud. There was none. March is the month for the woodcock's return migration. All things considered this appeared to be just a stopover and not its winter habitat. But why did it have to rest after such a short journey, or was it commuting between the upper and lower plateaux especially since it was considered a poor year for woodcocks on the upper plateau.

PETER DAVIDAR

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13. OCCURRENCE OF *DICRURUS PARADISEUS LOPHORHINUS* (VIEILLOT) IN GOA (INDIA)

The Ceylon Crested Black Drongo, *Dicrurus paradiseus lophorhinus* is known to be an endemic race of Sri Lanka. It is 'confined to and moderately plentiful in the wet zone and lower hills but ascending Adam's peak to at least *c.* 1700 m (Henry)' as quoted by Ali and Ripley (p. 141, 1972).

While working on a recent bird collection from Goa, stored in the Zoological Survey of India, we came across a specimen of a female drongo conforming to the description of the race *lophorhinus* of Sri Lanka. The specimen, Z.S.I. Reg. No. 34088 was collected by Dr. V. C. Agrawal, 2 km south of Poinguinim Forest Rest House, Canacona, south Goa, on 22 December 1968 in a secondary teak plantation. According to the collector, this was one of the two, one chasing the other.

The measurements are as follows: Wing—141 mm; Bill (from skull)—36 mm, (from feathers) 30 mm and (from nostril) 20 mm; and Tarsus—26 mm. Tail (Central)—123 mm and (outer) 212 mm.

Excepting the outer tail feathers, the measurements of all the parts are akin to that of the Ceylonese birds. The maximum length of outer tail feathers were given 182 mm (Baker, p. 373). But in one specimen it measures 196 mm when in moult (Ali and Ripley, p. 141).

Baker (1924) gave it species rank and kept it under a separate genus *Dissemurlus* and mentioned its distribution to be Ceylon (Sri Lanka) and south Travancore (Kerala).

Sálim Ali (p. 277, 1969) writes 'The statement of Stuart Baker (Fauna 2:373-4) implying that *D. p. lophorhinus* is common in 'Travancore' and another in NIDIFICATION (2: 339) that 'it has been found breeding freely and in great numbers by J. Stewart (in Travancore)' are certainly incorrect. There are no other records or any skins from Kerala to confirm them.

The authenticity of its occurrence in India is now confirmed.

This record immediately raises the question as to the taxonomic status of this species. The collection of *Dicrurus p. paradiseus* by Grubh and Ali (1976) and by the Zoological Survey of India (1968-69, 1973 and 1978), from this area and the occurrence of *D. p. lophorhinus* from the same area as represented by this present specimen necessitates further study of this aspect.

ACKNOWLEDGEMENTS

We are grateful to the Director, Zoological Survey of India for enabling us to visit Bombay Natural History Society. In addition, we must acknowledge our sincere thanks to the Bombay Natural History Society for providing necessary facilities to work in their laboratory. Dr. Sálim Ali, Shri J. C. Daniel, Dr. Robert B. Grubh and Shri H. Abdulali took special interest in this problem and were of assistance in preparing this note.

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REFERENCES

ALI, SALIM (1969): Birds of Kerala, Oxford University Press, London.

ALI, SALIM & RIPLEY, S. D. (1972): Handbook of the Birds of India & Pakistan, together with those of Nepal, Sikkim, Bhutan and Ceylon. Vol. 5, Oxford University Press, Bombay.

BAKER, E. C. S. (1924): Fauna of British India, Vol. 2 Taylor and Francis, London.

——————(1933): The Nidification of the Birds of Indian Empire. Vol. 2, Taylor and Francis, London.

GRUBH, ROBERT, B. & ALI, SALIM (1976): Birds of Goa. *J. Bombay nat. Hist. Soc. 73*: 42-53.

14. SPARROW 'HELPING' NESTING BULBULS

In July 1978, Mrs. Perin Jejeebhoy showed me a partly-built nest of the Redwhiskered Bulbul (*Pycnonotus jocosus*) which was being built in her garden just off Bhulabhai Desai Road, Bombay, and referred to a female sparrow (*Passer domesticus*) being associated with the work. This seemed so extraordinary that I asked her to keep written notes of all that she saw and the following, which she commenced to write after the first 2 or 3 days appear to be worth recording:—

"22 July 1978—A pair was noticed building in a small bush 4′ high in my garden, very close to the house. A hen house sparrow brought nesting material and appeared to be trying to help.

23 July —Both bulbuls continued to build. The sparrow hung around.

24 July —Building continued with sparrow attendant in building the same nest. The bulbuls did not appear to appreciate the assistance.

25 July —As above, nest empty at 4 p.m.

26 July —No birds nearby, but c/1 at 6.30 p.m. None on nest at 9-30 p.m.

27 July —7-30 a.m. both bulbuls nearby. One settled on nest and when she flew off at about 8 a.m., there were 2 eggs. One sat on the nest after 11 a.m. for short irregular periods, making short flights, not far from nest.

28 July —More time spent on nest. At noon c/3. 5-15 p.m. no trace of either bird and no singing heard.

29 July —Bulbul(s) sitting off and on, but noticed the sparrow occupying the nest when bulbul absent.

30 July —Opening the grill door near the nest disturbed the birds, so nothing was done till 9-30 a.m. When opened at 9-30 a.m., the sparrow flew off the nest and there was no trace of the bulbuls.

"For the next 10 days, the nest appeared to be irregularly and half-heartedly attended during the daytime and we were beginning to worry about the fate of the eggs. The sparrow was often seen visiting the nest when the bulbuls were absent.

"On 10th August, however, there were two naked chicks in the nest. Both parents fed them on worms and berries, and also on red flowers from Ixora bushes round the garden.

"The nest was in a precarious condition on the 13th but our servant Carlos, who has a natural love and interest in birds and animals, fixed it securely with a wire.

"On the 14th, crows showed interest in the chicks and though the parents were in a dither, they made no attempt to attack them. On 18th evening, the chicks had clambered on to the edge of the nest and they had left the nest at 7-30 a.m. on the following morning. They were seen in the garden a couple of hours later, when though flying well, they were still fed by the parents. They were seen again on the 20th and then moved away.

"Assuming that incubation commenced after the laying of the full clutch (28th), the eggs hatched after 13 days and the chicks left the nest after 9 days.

"A happy ending which we hope will happen again next season."

The same or another pair have nested in another bush just 5 yards away and I have placed plastic rings upon the feet of 3 naked young in the nest today.

The ringing of a few birds which are left in the city limits would perhaps permit a closer examination of their social and other habits.

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HUMAYUN ABDULALI

15. DEFENCE OF THE NEST AGAINST MAN BY THE SALTWATER CROCODILE (*CROCODYLUS POROSUS* SCHNEIDER)

Several older records of nest defence against man by the Saltwater Crocodile have tended to be overlooked (Boake 1870, Shelford 1916 and Robinson 1948) and with modified behaviour resulting from several decades of heavy human exploitation of the species, the nest-guarding activities of the female have tended to be discounted. For instance Webb *et al.* (1977) found no evidence of nest-guarding of any kind in a detailed study of nesting in *C. porosus* in the Northern Territory of Australia and concluded,

"It is not known whether *C. porosus* protects the nest against predators or not."

Bustard (1967) noted the ease with which female *C. porosus* could be killed at the nest in Papua New Guinea, and Choudhury and Bustard (1979) provided recent data for the Andaman Islands (India).

We here confirm the presence of nest-guarding by the saltwater crocodile on the basis of a study extending over five nesting seasons in the Bhitar Kanika Wild Life Sanctuary, Orissa (India) and cite below a recent instance of defence of the nest against man observed during collection of eggs for captive hatching and rearing of young—a management tool practiced in this Sanctuary (Bustard 1975).

The nest was located on 16 May 1976 when it was only partly constructed. It was next visited between 0800 and 1000 hours on 29 May at which time two wallows were present, approximately 30-45 cm deep, and the female crocodile was motionless in the wallow immediately adjacent to the nest which had been constructed beneath a tree. One of us (S.K.) carefully photographed the female at the nest. The female, approximately 3 m in total length, was apparently not disturbed and was not facing the photographer. However, during photography the female uttered a guttural roar and turned towards the photographer who quietly retreated.

On 31 May a party of four including S. K. went to collect the egg sat 1200 hours. The female was again present in the wallow from which it charged at an assistant (who escaped by climbing the tree beside the nest). The three others also climbed trees. The female returned to the nest and lay on top of it. The assistant who first climbed the tree was unable to leave it as he was close to the crocodile's mouth. The party shouted but the crocodile remained on the nest, and then came right to the foot of the tree harbouring the assistant and looked upwards with open jaws. The crocodile returned to the nest and then again came back to this tree. The egg collection party were 'treed' for about thirty minutes. Eventually they threw sticks, and this combined with shouting, resulted in the female entering the first wallow and then the second wallow whereupon they made their escape. There can be no doubt that the female would have physically attacked the staff had they not been able to climb trees.

DISCUSSION

This observation on nest defence against man is noteworthy in that the crocodile persistently defended the nest against a party of four people. Bustard & Choudhury (1980) refer to actual attacks on people in recent years in the Andamans by presumed nest-guarding female *porosus*. In most, if not all parts of the range, *C. porosus*, there has been a long history of selection against females which guard their nest against man—such females being invariably killed. This selection continuous today. Choudhury and Bustard (1979) noted the loss of 5 out of 30 nest-guarding *porosus* (17%) to poachers in the Andamans in a single year (1978).

Accordingly we may safely assume that nest-guarding was commoner in former years and has been selected against by man—the only serious enemy of large *porosus*.

Nest-guarding against man is the highest level of nest defence possible. Like all wild animals *C. porosus* is extremely frightened of man and avoids him at every opportunity. Furthermore, the continued presence of the crocodile at the nest after man's approach (the crocodile has ample warning in the mangroves) is in itself a clear modification of normal behaviour and must be held to be defensive of the nest even without actual attack on man.

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REFERENCES

BOAKE, B. (1870): The nest of the Crocodile. *Zoologist* (2) 5: 2002-4.

BUSTARD, H. R. (1967): Report on the Crocodile Skin Trade in the Territory of Papua New Guinea with Recommendations for the Future Development of the Industry. Unpublished Report to Government.

——————— (1975): Gharial and Crocodile Conservation Management in Orissa. Interim Report. Crocodile Farming Project India. UNDP/FAO. Rome, 1975 (FO/IND/71033).

CHOUDHURY, B. C. & BUSTARD, H. R. (1979): Predation on Natural Nests of the Saltwater Crocodile (*Crocodylus porosus* Schneider) on North Andaman Island with Notes on the Crocodile Population. *J. Bombay nat. Hist. Soc. 76* (2): 311-323.

BUSTARD, H. R. & CHOUDHURY, B. C. (1980): Parental care in the Saltwater Crocodile (*Crocodylus porosus* Schneider) and management implications. ibid. *77* (1): 64-69.

ROBINSON, ST. J. (1948): The Crocodile at the Nest. *North Queensland Naturalist. 16* (88): 3-4.

SHELFORD, R. W. C. (1916): A Naturalist in Borneo. London, Fisher Unwin.

WEBB, G. J. W., MESSEL, H. & MAGNUSSON, W. (1977): The Nesting of *Crocodylus porosus* in Arnhem Land, Northern Australia. *Copeia, 1977* (2): 238-250.

16. SOME OBSERVATIONS ON THE GROWTH OF CAPTIVE CROCODILES

(*With five text-figures*)

Two species of crocodiles—*C. palustris* and *C. porosus* were reared in captivity to evaluate the feasibility of growing them in view of the commercial importance of their skins. The effect of physical factors of environment on their growth rates have been statistically analysed. The economics of their rearing is also indicated.

INTRODUCTION

It has been known for a long time that illegal poaching encouraged by the high profitability of foreign trade in crocodile skins has reduced the crocodile population in India almost to the verge of extinction (Misra 1970). Information regarding crocodile farming on a commercial scale is sparse except for those of Youngprapakorn *et al.* (1971). This had necessitated the urgent need for setting up of crocodile farms which has assumed importance after the survey by Bustard (1974). In view of these considerations an attempt was made in this Institute to rear *C. palustris* and *C. porosus* in captivity. The difference in growth rates between these two species has already been mentioned (Krishnamurthi and Bhaskaran 1976). The present paper throws more light on the effect of climatic conditions

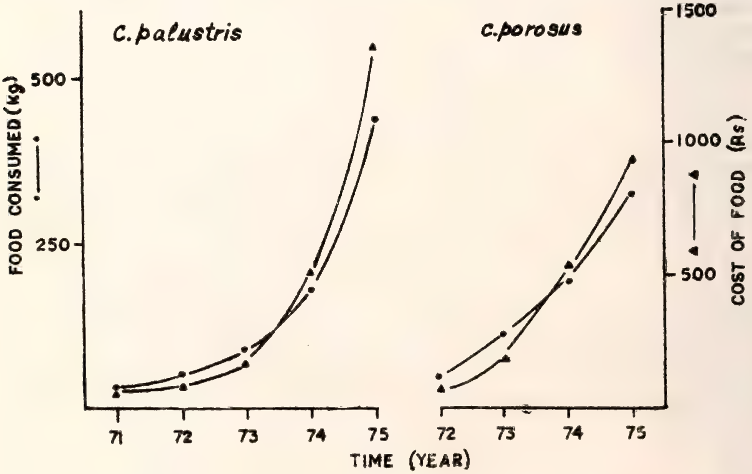

Fig. 1. Food consumption by *C. palustris* and *C. porosus*.

and food on their growth in captivity. The cost of rearing them under artificial conditions is also indicated as an aid for commercial farming of crocodiles.

Materials and Methods

C. palustris: Sixteen hatchlings of about 15 days old were obtained from Chidambaram, Tamilnadu in 1970. Two of them died within a week while eight of the remaining died at different intervals during the course of the year. Of the remaining, one was transferred to the Snake Park, Madras for observation and only five were maintained for further study.

*C. porosus*s Eight specimens, ranging from 1½ to 2 years old were imported from Singapore in March 1972 to compare the rate of growth with that of *C. palustris*. One of them died within 15 days after an attack of paralysis of hind limb and another two during the year. Five survived for the full study period.

Rearing Tanks:

In the early stages, juveniles of *C. palustris* were reared in wooden tubs and small cement tanks and later transferred to big tanks. Two tanks, measuring 21′ × 14′ and 14′ × 9′ respectively with 3′ depth (Pooley 1971) were used from February 1973. The two species were segregated according to their sizes. The sides and the roof of the enclosure were covered with wire netting against predators.

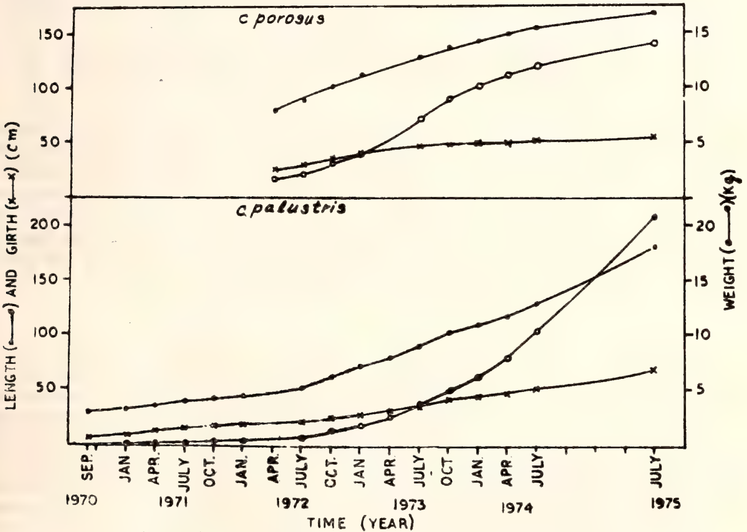

Fig. 2. Growth measurements of *C. palustris and C. porosus.*

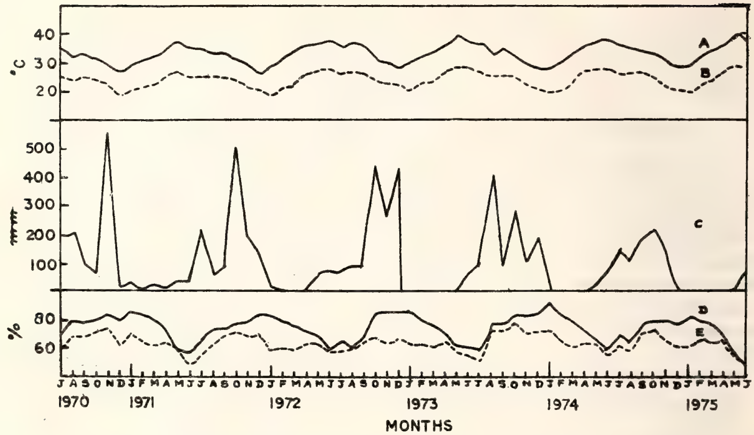

Fig. 3. Meteorological data for the period July 1970 to June 1975. A—Maximum Temperature; B—Minimum Temperature; C—Monthly total rainfall; D. Relative humidity at 08.30 hrs; E—Relative humidity at 17.30 hrs.

Food: The food consisted of beaf, live frogs and fish. Feeding with live frogs was discontinued from April 1973, due to non-availability of sufficient size and numbers. As daily feeding resulted in too much left over food the feeding intervals were reduced. In summer feeding was done on alternative days and in cold months on every third day (October to January).

Data analysis:

Using multiple regression analysis, the relationship between length, girth and weight was analysed using IBM—370/155. The values of R^2 and chi-square (*C. palustris*, $R^2 = 0.98$, chi-square (74 df) = 21.02, *C. porosus*, $R^2 = 0.96$, chi-square (49 df) = 11.05) were very highly significant showing a high order of correlation between length, girth and weight. In view of this, length has been taken as a parameter to decide the growth rate. Since rainfall which is a discrete factor can only have a cumulative effect on this growth, the effect of cumulative rainfall on the length has been worked out on the assumption that line correlationship exists between rainfall and growth (Arkin and Colton 1967).

RESULTS

It is known that juvenile crocodiles develop deformities like hunchback when fed with beef alone (Coulson *et al.* 1973). This was also observed in the present investigation with juvenile *C. palustris* exhibiting deformities under similar feedings. There was considerable improvement in growth with a change in diet to live frogs and fish. Further, the young ones took about two weeks to adapt themselves to the new surroundings when shifted from smaller to larger tanks. The other species under the present study namely *C. porosus* was fed with live frogs and fish from the beginning and the growth was observed to be normal. The consumption of food initially by *C. palustris* was very poor and with the increase in its size it doubled every year from 1972 onwards. In the case of *C. porosus* there was a drop in the food consumption (Fig. 1) from 1973. It was estimated that the cost of feeding of *C. palustris* for 58 months amounted to Rs. 2170/- while as with reference to *C. porosus* it was Rs. 1735 for 40 months.

The growth rate of the two species was recorded at regular intervals. It included length, girth and weight and the average measurements of five individuals of each spe-

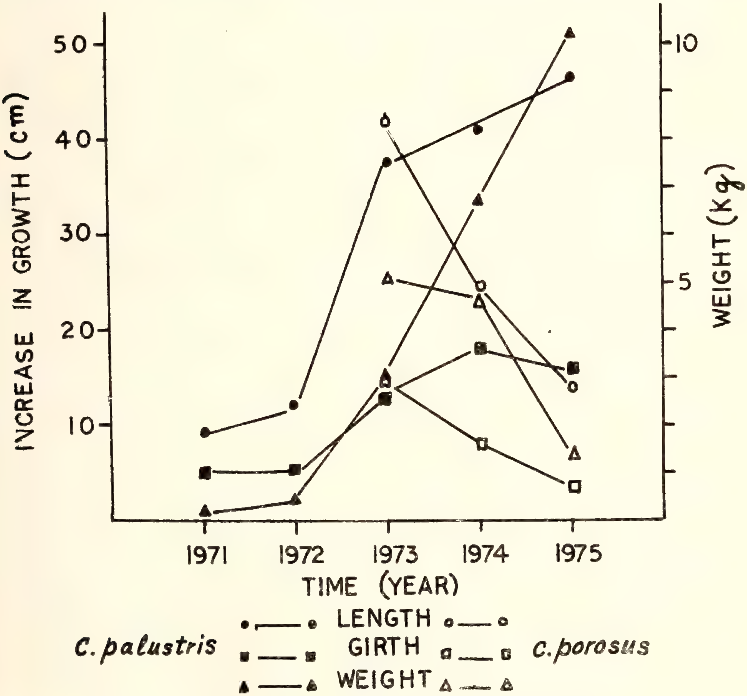

Fig. 4. Average increase in growth rate per year (July-June).

cies are presented in Fig. 2. It was observed that in the case of *C. palustris* the average maximum figures for length, girth and weight were 176 cm, 67 cm, and 20.5 Kg respectively while in *C. porosus* these were 167 cm, 55 cm and 13.7 Kg. in the same order. As between two species, the annual growth rate of *C. porosus* seems to be influenced to a considerable extent by annual cumulative rainfall while *C. palustris* seems to maintain a steady increase in its growth rate. As indicated in Fig. 3 the annual rainfall increased steadily from 1970, to 1525 mm in 1972, and it decreased during the years 1973 and 1974 to 1191 and 873 mm respectively. However, there was no significant difference in the temperature and the relative humidity during the year of study.

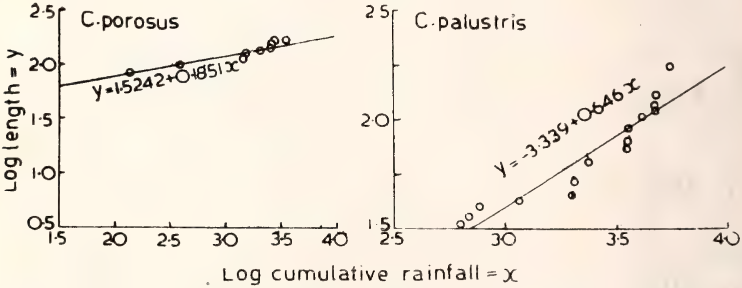

Fig. 5. Scatter diagram—relationship between cumulative rainfall and length of Crocodile.

Discussion

In assessing the factors influencing the value of the skins it is obsrved that as between food and environmental factors, the latter especially the cumulative rainfalls plays a more effective role than the former (Youngprapakorn *et al.* 1971). There also seems to be a certain relationship between the urge to consume food and the amount of rainfall, a decrease in rainfall resulting in aversion to food in general, which is more pronounced in the case of *C. porosus*. Similar observations were made with alligators (Coulson *et al.* 1973). *C. palustris* showed a steady increase in its annual growth rate from 9.1 cm long in 1970-71 to 11.7 cm in 1971-72, 37.7 cm in 1972-73, 41 cm in 1973-74 and 44.5 cm in 1974-75, while *C. porosus* affected by rainfall, recorded a decrease from 41.7 cm in 1972-73 to 24.3 cm in 1973-74 and 14.2 cm in 1974-75 (Fig. 4). This observation has been substantiated by statistical analysis (Fig. 5) in which it is highlighted using a log plot of the length against the cumulative rainfall. The log-linear relationship is evident from the gord fit and a regression equation is generated to explain the relationship. In the case of *C. porosus* the regression equation is log (length) = 1.5242 + 0.1851 log (cumulative rainfall) while in *C. palustris* it is log (length) = —3.339 + 0.646 log (cumulative rainfall).

After the period of this study the crocodiles were transferred to a natural habitat.

ACKNOWLEDGEMENTS

Thanks are due to Dr. R. Sanjeevi and Dr. (Mrs.) Padmini Ramaswamy, CLRI, Madras, for statistical evaluation and Dr. N. Ramanathan, Acting Director, CLRI, Madras for his kind permission to publish the results.

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REFERENCES

ARKIN, H. & COLTON, R. R. (1976): Statistical Methods. Barnes & Noble Inc. New York.

BUSTARD, H. R. (1974): A preliminary survey of the prospects for Crocodile farming (UNDP, Food and Agricultural Organization of the United Nations, Rome FO: INS/71/033).

COULSON, T. D., COULSON, R. A. & HERNANDEZ, T. (1973): Some observations on the growth of captive alligators. *Zoologica.* Scientific contributions of the New York Zoological Society. *58*(2): 47-52.

KRISHNAMURTHI, V. S. & BHASKARAN, R. (1976): Growth studies on the species of Crocodiles in captivity. *J. Bombay nat. Hist. Soc., 73*(3): 532-533.

MISRA, R. N. (1970): The endangered crocodiles of India. IUCN Publ. (N.S.) No. *18*: 77-81.

POOLEY, A. C. (1971): Crocodiles rearing and restocking IUCN publications on the proceedings of the First working Meeting of Crocodile specialist group held in USA 1:104.

YOUNGPRAPAKORN, U., CRONIN, B. N., & MCNEELY, J. A. (1971): Captive breeding of Crocodiles in Thailand, In Crocodiles Intern. Union Consen. Nat. Publ. New series, Suppl. Pap. *32*: 98-101.

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17. A NEW TURTLE FOR NEPAL

In their appendixed review of the Nepal herpetofauna, Swan and Leviton (1962:135) list the turtle *Kachuga tecta,* family Emydidae, as a hypothetical species and note that it occurs in the adjacent plains of Nepal, defined as "the plains of India within approximately 50 miles of the southern frontier of Nepal." They further state that for west, central, and east Nepal they suspect the "possible presence of the species in Nepal based on the known presence of the species on the plains of India adjacent to Nepal." I would now like to report the first authenticated specimen in Nepal.

On the 27 of May, 1977, I caught, photographed, and released an individual of this species in Janakpur, Dhanusa district, of east Nepal. The total carapace length measured 8.5 cm. I had earlier seen two turtles of this species at the Janakpur fish farm in January of that year. I subsequently again captured individuals of *K. tecta* at the Janakpur fish farm. *K. tecta* is found to regularly occur in the pond opposite Ram Mandir in Janakpur. I suspect the range of this species in Dhanusa district to be from the Nepal-Bihar border north to just south of the east-west highway, as suitable habitat is known throughout that area. Further north lies the Bhabar zone, contiguous to the southern slope of the Siwalik hills, an area lacking in surface water resources to support the occurrence of *K. tecta.* I have previously reported this finding along with documented photographs to the Robert L. Flemings of Kathmandu, Nepal.

I gratefully acknowledge the assitance of the Dr. Flemings in reviewing this paper.

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REFERENCES

SWAN, LAWRENCE W. AND LEVITON, ALAN E. (1962): The herpetology of Nepal: a history, check list, and zoogeographical analysis of the herpetofauna. Cal. Acad. of Science. Vol. XXXII, No. 6, pp. 103-147, 4 figs.

18. FIRST RECORD OF THE MILK FISH, *CHANOS CHANOS* (FORSKAL, 1775) FROM IRAN AND THE PERSIAN GULF

The milkfish is a euryhaline, littoral marine species found from the Red Sea and the east coast of Africa through the Indian Ocean to Japan and Australia and through the Pacific Ocean to the west coast of North America (Schuster 1960). It is an important food fish which can be cultured in water of various salinities and its natural distribution is therefore of interest, particularly in respect to the Persian Gulf where adverse environmental conditions do not favour production of protein on the adjacent land and protein consumption of local populations is deficient (Surber 1969).

Eleven specimens of the milkfish were picked up dead from the Baghu River, Hormozdgan Province, Iran (27°18′N, 56°27′E) on 27 November 1976. This locality lies about 14 river kilometres from the Persian Gulf at the Strait of Hormuz. There has not been any previous record of this species from Iran or the Persian Gulf despite surveys by Blegvad and Loppenthin (1944), Khalaf (1961), Mahdi (1962), Kuronuma and Abe (1972) and Saadati (1977). Boulenger (1887) reported the milkfish from Muscat, about 460 km. southeast of the Baghu River.

Meristic and morphometric data are given below and are in general agreement with published information for other parts of the species range (Schuster 1960, Fowler 1956, Day 1875-1878, Misra 1976). Some differences in morphometry are due to these measurements having been made on juvenile specimens which also have the distal parts of paired fins fragmented. Schuster (1960) notes that the head is relatively shorter and broader in older specimens. Dorsal fin IV 11-12, anal fin III 7-8, ventral fin 9-11, total vertebrae including hypural plate as one vertebra 42-43, lateral line scales to hypural plate 70-79, scales above lateral line 11-14, below lateral line 10-12, predorsal scale rows 18-23. Morphometric data is based, like meristic data, on all 11 specimens unless total length or caudal fin length is involved. Three specimens had an incomplete, damaged caudal fin precluding measurement of total length and caudal length; these specimens fell within the range of total length given below judging by their standard lengths. The range for each morphometric character is followed by the mean and standard deviation in parentheses where appropriate. Total length 91.8-128.9 mm (mean 112.5); standard length 70.5-98.5 (mean 86.91); head length in total length 4.35-4.71 (4.52, 0.1314); caudal fin length in total length 3.83-4.23 (4.05, 0.1447); body depth in total length 5.65-6.39 6.01, 0.2371); head length in standard length 3.34-3.57 (3.47, 0.0813); body depth in standard length 4.32-4.79 (4.63, 0.1494); orbit diameter in head length 2.88-3.13 (2.99, 0.0832); snout length in head length 4.03-4.57 (4.32, 0.1819); interorbital width in head length 3.32-3.58 (3.45, 0.1165); maxilla length in head length 3.80-4.59 (4.28, 0.2315); orbit diameter in snout length 0.64-0.77 (0.69, 0.0456); orbit diameter in interorbital width 0.82-0.91 (0.87, 0.0305); pectoral fin length in head length 1.65-1.87 (1.75, 0.0665); pelvic fin length in head length 2.17-2.79 (2.54, 0.2016); caudal fin length in head length 0.81-0.96 (0.90, 0.0424); anal fin base length in dorsal fin base length 1.77-2.23 (2.03, 0.1398).

The specimens were found in a warm, shallow, mud-bottomed backwater which had a temperature of 16°C after some insolation. Mortality was probably due to exposure to low temperatures in the colder main watercourse. Milkfish become paralysed at 13°C and die at about 12°C even higher temperatures where exposure is prolonged (Schuster 1960). Temperature is also the factor most likely to be responsible for the absence of milkfish from the Persian Gulf since surface water temperatures fall below 19°C, and in certain littoral areas below 15°C, in winter. Any attempt at culturing this species in the Gulf would therefore require a source of heated water in winter, particularly for shallow ponds, as air temperatures can fall below 0°C in winter.

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REFERENCES

BLEGVAD, H. AND LOPPENTHIN, B. (1944): Fishes of the Iranian Gulf. Einar Munksgaard, Copenhagen. 247 p. & 12 plates.

BOULENGER, G. A. (1887): An account of the fishes obtained by Surgeon-Major A. S. G. Jayakar at Muscat, east coast of Arabia. *Proc. Zool. Soc. Lond. 1887*: 653-667.

DAY, F. (1875-1878): The fishes of India being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma, and Ceylon. 2 vols., Today and Tomorrow's Book Agency, New Delhi. (1967 reprint).

Fowler, H. W. (1956): Fishes of the Red Sea and southern Arabia. Vol. 1. Branchiostomida to Polynemida. Weizmann Science Press of Israel, Jerusalem. 240 p.

Khalaf, K. T. (1961): The marine and fresh water fishes of Iraq. Ar-Rabitta Press, Baghdad. v & 164 p.

Kuronuma, K. and Abe, Y. (1972): Fishes of Kuwait. Kuwait Institute for Scientific Research, State of Kuwait. xiv & 123, p., 37 figs., 20 plates.

Mahdi, N. (1962): Fishes of Iraq. Ministry of Education, Baghdad, 82 p.

Misra, K. S. (1976): The fauna of India and adjacent countries. Pisces. Vol. II, 2nd Ed. Zoological Survey of India, Calcutta. xxvii & 438 p., 11 plates.

Saadati, M. A. G. (1977): Taxonomy and distribution of the freshwater fishes of Iran. MS Thesis, Colorado State Univ., Fort Collins, Colorado. xiii & 212 p.

Schuster, W. H. (1960): Synopsis of biological data on milkfish *Chanos chanos* (Forskal), 1775. FAO Fisheries Biology Synopsis No. 4, vi & 58 p.

Surber, E. W. (1969): Report to the government of Iran on a programme for the development of the inland fisheries of Iran. FAO UNDP/TA, 2723: viii & 64 p.

19. OCCURRENCE OF *ZEBRIAS KERALENSIS* JOGLEKAR (PISCES: SOLEIDAE) OFF VISAKHAPATNAM, WITH A NOTE ON ITS TAXONOMY

One soleid flat fish, belonging to the genus *Zebrias* Jordan & Snyder, was collected from trawl catches off Visakhapatnam, and identified as *Zebrias keralensis* Joglekar. Hitherto it has been recorded only from the Arabian Sea, at Aleppy on Kerala Coast (South West India). The present record extends the distribution of the species to the North East Coast of India also.

Material: One specimen measuring 120.0 mm (S.L.), collected from trawl catches, off Visakhapatnam, on 30-12-78.

Description: Counts: D.67; A.57; C.17; P. (eyed) 13; P. (blind) 11: V. 4; L. 1.83.

Measurements: Depth of body 41.6, length of head 20.8 per cent of S.L. Snout 24.0, Eye diameter 20.2, Post orbital distance 60.6, Snout to angle of mouth 32.0, angle of mouth to gill opening 64.0, length of right pectoral 36.0, length of left pectoral 20.0 per cent of head length.

Coloration: In formalin, light brown with 13 dark cross bands extending on to vertical fins. Third cross band spindle shaped. Pectoral on ocular side dark. Caudal dark with white spots. Blind side white.

Diagnosis: The specimen agrees with the description of *Z. keralensis*, which can be easily distinguished from the closely resembling *Z. synapturoides* on the basis of Lateral line scale count (75-93), and longer pectoral fin on ocular side (33-42 % in head), characteristic of the species. The range of scale count of *Z. keralensis* includes that of *Z. cochinensis* Rama Rao (1967).

Taxonomic note: Rama Rao (1967), described *Zebrias cochinensis* as a new species, on the basis of single specimen collected at Cochin, off Vypeen Island. The morphometric measurements and meristic counts of *Z. cochinensis* are not different from those of *Zebrias keralensis* Joglekar (1976). There is however a marked difference in the band pattern and caudal fin ray count, while the counts of ventral fin rays and pectoral fin rays show slight variation. In *Z. keralensis* the counts are C.17-18; V.4; P. (eyed) 10-13, whereas in *Z. cochinensis* the counts are C. 14; V.5; P. (eyed) 14. The band pattern in *Z. keralensis* is characteristic of most *Zebrias* spp., in having vertical bands extending on to the dorsal and anal. The number of bands may vary from species to species but all the bands in all the species are transverse. The band pattern in *Z. cochinensis* is most uncharacteristic of any *Zebrias* sp., as the bands in the region of the 2nd, 3rd and 4th on the trunk, instead of being vertical, assume a semilunar shape. This deviation from the normal pattern of *Zebrias* spp. coupled with the reduced number of caudal fin ray count does not allow *Z. cochinensis* to be congeneric with other *Zebrias* spp. Thus *Z. cochinensis* appears to be an abnormal freak specimen with modified band pattern but otherwise agreeing in all the other characters with those of *Z. keralensis*, excepting the marked difference in caudal fin ray count. The caudal fin ray count of any *Zebrias* spp., falls in the range of 16-18 (Day 1878, Norman 1928, Chen & Weng 1965, Talwar & Chakrapany 1967, Joglekar 1976). Ochiai (1963) extended the lower range upto 15 in the case of *Z. fasciatus* and *Z. zebra*, in which the caudal is completely confluent with dorsal and anal. This character is very difficult for accurate count in the species in which the caudal is completely confluent with dorsal and anal. As the character does not show much variation between the different *Zebrias* spp., the count given for *Z. cochinensis* is perhaps either a typographical mistake or alternately an additional freak character. As the validity of *Z. cochinensis* as a species distinct from *Z. keralensis* is doubtful, it is preferred to name the present specimen after *Z. keralensis*. Accepting that the caudal fin ray count is a typographical mistake and considering that band pattern could be an abnormal feature (which is not uncommon in family Soleidae, according to Ramarao 1967, and Chakrapani & Ramarao 1977), *Z. cochinensis* appears to be a synonym of *Z. keralensis*.

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REFERENCES

CHAKRAPANY, S. & RAMA RAO, K. V. (1977): Remarks on the abnormal band pattern of the sole *Aesopia cornuta* Kaup. (Pisces: Soleidae) from Madras Coast. *Science and Culture. 43*: 442.

CHEN, J. T. F. & WENG, H. T. C. (1965): A review of the Flat fishes of Taiwan, Published by Tunghai Univ., China. *Biological Bulletin 27*: 39-44.

DAY, F. (1878): The Fishes of India. (Reprinted ed., 1958), Dawson, London. p. 430-431.

JOGLEKAR, A. (1976): On a New Species of the Genus *Zebrias* Jordan and Snyder, 1900 (Pisces: Soleidae) from Kerala Coast (India). *Zool. Anz.*, Jena 197.Y2, S.67-70.

NORMAN, J. R. (1928): The Flat fishes (Heterosomata) of India, with a list of the specimens in the Indian Museum. *Rec. Indian Mus.* *30*: 182-185.

OCHIAI, A. (1963): Soleina. *Fauna Japonica*: 53-59.

RAMA RAO, K. V. (1967): A new Sole *Zebrias cochinensis* from India. *J. Zool. Soc. India.* *19* (1 & 2): 99-100.

——— (1967): Remarks on the band pattern of the Sole *Zebrias synapturoides* (Jenkins). J. Bombay *nat. Hist. Soc.* 64(1): 119-120.

TALWAR, P. K. & CHAKRAPANY, S. (1967): A new flat fish of the genus *Zebrias* Jordan and Snyder (Soleidae) from the Orissa Coast, India. *Proc. Zool. Soc.*, Calcutta. *20*: 119-121.

20. ON THE RECORD OF THE BLACK RUBY BARB, *PUNTIUS NIGROFASCIATUS* (GUNTHER) (PISCES: CYPRINIDAE) FROM INDIA

(*With a text-figure*)

Yazdani (1977) reported the occurrence of *Puntius nigrofasciatus* (Gunther) based on six specimens of fish collected from a small rivulet in the forest area of Ponda (Goa), and claimed it as a new record of this fish from India. This fish had earlier been recorded only from Sri Lanka.

In the course of extensive collections throughout the Deccan region, we had not come across any specimens of *P. nigrofasciatus*. It was, therefore, a matter of surprise to us to read about this new record. From Sanguem, Goa (25 kilometres from Ponda as the crow flies) the second author (S.R.S.) has been collecting hundreds of specimens of another barb, *Puntius narayani* Hora. This fish resembles the Black Ruby barb in general coloration, having three vertical black bands on its body, but lacking the characteristic black coloration on the dorsal, anal and pelvic fins (which is prominent in *P. nigrofasciatus*). We, therefore, surmised that the specimens identified by Yazdani as *P. nigrofasciatus* might actually be *P. narayani*.

P. narayani was first described by Hora in 1937 from the Cauvery river in Coorg, and it closely resembles *P. nigrofasciatus* not only in its colour pattern, as stated earlier, but also in having a complete lateral line and in the absence of barbels. The fin-ray and other counts for the two species are as follows:—

P. nigrofasciatus (as given by Day): D. 3/8; A. 2/5; P. 15; V. 9; C. 19; L. 1. 20-21.

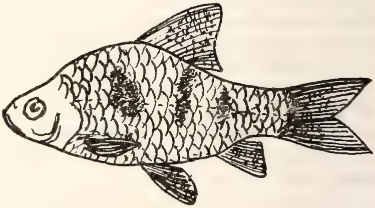

Fig. 1. *Puntius narayani* Hora (after Hora, 1937).

P. nigrofasciatus (as given by Munro): D. 3/8; A. 3/5; P. 1/12; L.1. 20-22; L. tr. 8 $(4\frac{1}{2}+3\frac{1}{2})$.

P. narayani (as given by Hora): D. 3/9; A. 3/6; P. 14; V. 9; C. 18; L.1. 22; L.tr. 9 $(4\frac{1}{2}+4\frac{1}{2})$.

In the absence of an opportunity to examine the actual specimens determined by Yazdani, our surmise that these specimens might not be *P. nigrofasciatus* could not be definitely ascertained. In August, 1979 we could examine two of his specimens in detail, while on loan from the Zoological Survey of India to the Curator, Taraporevala Aquarium. The label accompanying these two specimens read:

Puntius nigrofasciatus (Gunther)

Locality: A small rivulet in the forest at Ponda (Goa). Date: 13-12-73. Collector Dr. B. S. Lamba. Det. by G.M.Y.

From these detalis it appeared quite certain that the fishes mentioned by Yazdani in his note (cited above) as "collected from a small rivulet in the forest at Ponda, Goa" were the same that were loaned by the Zoological Survey of India for examination. Our examination of these specimens confirmed our earlier suspicion that the fishes claimed by Yazdani to be *nigrofasciatus* were really *P. narayani*.

P. nigrofasciatus is a popular fish in the home aquarium hobby, and as such, specimens are readily available (on sale in pet shops) in large cities like Bombay, Pune, Delhi, etc.

Yazdani (op. cit.) has attempted to give an explanation for the occurrence of his so-called *P. nigrofasciatus* in Goa, stating that the fish first evolved in the Western Ghats and subsequently migrated to Sri Lanka. Had this been so, the fish would also be likely to occur in Kerala or southern Tamilnadu. Moreover, Yazdani has not given any palaeontological evidence to corroborate his hypothesis.

We are grateful to Shri J. N. Pande, Curator, Taraporevala Aquarium, Bombay, for allowing us to examine the Ponda specimens while on loan from the Zoological Survey of India.

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REFERENCES

Yazdani, G. M. (1977): On a new record of Black Ruby, *Puntius nigrofasciatus* (Gunther) from India (Cypriniformes: Cyprinidae). *Curr. Sci. 46* (21): 760.

21. LOCAL NAMES OF POMFRETS FROM THE INDIAN COASTS

Pomfrets are highly esteemed as tablefish and are acclaimed as one of the tastiest fishes of the world. Because of their commercial importance they are eagerly sought after by fishermen. In Indian waters, promfrets are represented by three species, namely silver pomfret (*Pampus argenteus* Euphrasen), Chinese or grey pomfret (*Pampus chinensis* Euphrasen) and black pomfret (*Formio niger* Bloch). Diverse local names are applied to these fishes, along the vast stretch of the Indian coast and a knowledge of such names is of importance to fishery scientists, administrative officers, fish merchants and fishermen. Day (1878) in his monumental work gave some local names but they were in no way exhaustive. Kulkarni (1953) and Mohapatra (1966) have listed the local and scientific names of commercial fishes of Bombay and Orissa respectively. A list of local names of pomfrets collected by me from different regions of the entire Indian coast is given in the Table.

In certain localities fishermen apply different local names for the same species. The situation is confusing where the same local name is applied to two different species. This is true of silver pomfret and the Chinese pomfret. However, the silver pomfret can be easily recognised by its falcate median fins preceded by stubby spines and deeply forked caudal fin with a longer ventral lobe. In the Chinese pomfret the median fins are not falcate, the spines are altogether absent and the caudal fin has almost equal lobes.

TABLE

LIST OF LOCAL NAMES OF POMFRETS FROM THE INDIAN COASTS

State	Silver pomfret	Chinese pomfret	Black pomfret
Gujarat	Vichuda, Pipad, Chamana	Vichuda Chamana	Adadia
Maharashtra	Saranga, Paplet	Kalwad, Kafri Saranga, Chandva	Halwa
Karanataka	Bilimanji	Bilimanji	Karimanji
Kerala	Velutha avoli	Velutha avoli	Karutha avoli
Tamil Nadu	Vellai vavval	Vellai vavval	Karuppu vavval
Andhra	Tella chanduva	Tella chanduva	Nala chanduva
Orissa	Chandee, Ghia Chandi, Firki	Dhala Chandi Chandi bahal	Bahal, Kala chandi. Mainsia bahal
West Bengal	Chandi, Firki	Chandi bahal	Bahal

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REFERENCES

DAY, F. (1878): Fishes of India. Vol. I. Text XX 778 pp. and Vol. II, Atlas—198 pls.

KULKARNI, C. V. (1955): Local and scientific names of commercial fishes of Bombay. *J. Bombay nat. Hist. Soc. 51*(4): 917-925.

MOHAPATRA, P. (1966): Local names of common sea fishes of Orissa. *Orissa Fish. Res. Invest. Bull., 1*: 1-11.

22. SEXUAL DIMORPHISM IN *LOHITA GRANDIS* GRAY (HETEROPTERA-PYRRHOCOREIDAE)

Distant (1902) gave details of distribution of the bug *Lohita grandis* Gray in the Oriental region. It was Lefroy (1909), who for the first time, recorded this bug in Bengal and Assam (India). He, further, stated that this bug is sometimes a pest of cotton and bhindi. During a survey of the Shiwalik Hills forest (near Hardwar and Raiwala), this species was observed in abundance sucking the sap of fruits, seeds and leaves of some forest trees.

Interestingly sexual dimorphism was observed in this bug which is rare in other heteropteran insects. It is a large red and black species. The length of the male varies from 3.9 cm to 5.4 cm while that of the female from 2.9 cm to 3.3 cm. Length of the abdomen of male is 2.80 cm and that of female is 2.00 cm. Total length of the antenna of male is 6.30 cm and that of female is 3.60 cm. Comparative length of the antennal segments (scape, pedicel, flagellum first and second) of male is 2.60:2:00:1.30:0.40 and of female is 1.30:1.10:0.80:0.40 (in cm). Rostrum of male is 1.80 cm long and of female is 1.65 cm. Comparative lengths of rostral segments in male and female sexes are 0.50:0:60:0:50:0:20, and 0.50:0:50:0:45:0.20 cm respectively. Length of prothoracic, mesothoracic and metathoracic legs in male is 3.10, 3.10 and 4.00 cm while in female 2.50, 2.50 and 3.30 cm respectively. During rest, the tip of the rostrum of female reaches up to the third abdominal sternum while in male it extends up to second sternum. Length of fore wings and hind wings of male is 2.40 and 1.90 cm, and that of female is 2.10 and 1.70 cm respectively. In female, wings extend up to the 5th abdominal tergum while in male upto the 4th tergum. The abdomen of male is abnormally elongated. Length of exposed caudal end of the abdomen of male is 1.20 cm and that of female is 0.35 cm.

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REFERENCES

Distant, W. L. (1902): Fauna of British India Rhynchota Vol. II, pp. 95-96.

Lefroy, H. M. (1909): Indian Insect Life. pp. 691. Thacker Spink & Co. Ltd.

23. OCCURRENCE OF *EPILACHNA OCELLATA* REDT. ON BITTER GOURD, *MEMORDICA CHARANTIA* L. WITH A NOTE ON ITS DAMAGE AND BIOLOGY

The coccinellid beetle,, *Epilachna ocellata* Redt. (Coccinellidae: Coleoptera) was reported as a serious pest of potato, *Solanum tuberosum* in higher hilly areas of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and Bengal by Misra (1975). Jolly (1962) gave a brief account of biology and bionomics of this insect. So far no host plant other than potato has been recorded. However, for the first time the incidence of *Epilachna ocellata* on bittergourd ('Kerala', *Memordica charantia*) at Jabalpur (Madhya Pradesh) was observed by us.

TABLE

LIFE-CYCLE PERIOD, LONGEVITY AND PER CENT SURVIVAL OF DEVELOPMENTAL STAGES OF *Epilachna ocellata*

Date of egg laying	Number of eggs under observation	Incubation period (in days)	Larval period (in days)	Pupal period (in days)	Life-cycle period (in days)	Longevity (in days) ♂	♀
13.ix.77	20	3.33 + 0.68 (18)	21.42 + 5.80 (14)	3.30 + 0.67 (13)	28.05	21	31
20.ix.77	20	3.41 ± 0.77 (17)	18.31 ± 4.61 (16)	4.56 ± 1.04 (16)	26.28	27	34
11.xi.77	20	4.70 ± 1.65 (17)	23.53 ± 6.15 (15)	3.35 ± 0.79 (14)	31.58	18	25

Figures in parentheses represent number of observations.

During September-October, 1977, severe incidence of *Epilachna ocellata* was noticed on bittergourd vines in the Kitchen gardens at Krishi Nagar, J. N. Krishi Vishwa Vidyalaya, Jabalpur.

Both the adults and grubs feed on the leaves, usually on the undersurface, and an infested leaf may habour 1 to 8 grubs and 1 to 2 adults.

The duration of different stages of the insect and the longevity of the male and female are given in the Table.

It may be seen from the table that the incubation, larval and total life cycle periods of the beetle is longer during November but slightly low during September. This might be due to decrease in temperature and cooler weather conditions.

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REFERENCES

JOLLY, C. L. (1962): Biology and bionomics of *Epilachna ocellata* Redt. *Indian Potato J. 4* (1): 17.

MISRA, S. S. (1975): Residual toxicity of six insecticides to the adults of Epilachna beetle. *J.I.P.A.* *2*(1): 23-24.

24. DRAGONFLIES FEEDING ON HOUSEFLIES

Dragonflies are well known predators of certain harmful insects such as mosquitoes and termites (Corbet 1962, Tillyard 1967). Instances of dragonfly predation on the common housefly, *Musca domestica*, has not been recorded earlier and seems worthwhile to report.

Two species of dragonflies, namely, *Anax immaculifrons* Rambur and *Orthetrum sabina* (Drury) have been observed predating upon house-flies. *O. sabina*, was often captured while still holding a live house-fly between its mandibles. Males of *O. sabina* were caught on September 3, 1979 and July 28, 1980 just after they had pounced on a house-fly. The dragonfly held the prey by its neck using the forelegs to clasp and support from below. At this time the body of the dragonfly is perpendicular to the axis of the house-fly body. First, the dragonfly devoured the head of its victim, and then proceeded to eat the remaining body, except the wings which it rejected. The time taken by *O. sabina* in fully devouring a house-fly does not exceed one minute.

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FOREST ENTOMOLOGY BRANCH,
FOREST RESEARCH INSTITUTE & COLLEGES,
DEHRA DUN 248 001, U.P.,
August 28, 1980.

REFERENCES

CORBET, P. S. (1962): A biology of dragonflies, Witherby, London.

TILLYARD, R. J. (1967): The biology of dragonflies, Cambridge Univ. Press. London

25. MORE BUTTERFLIES FROM BOMBAY

In 1951 (*JBNHS* 50:331) A.E.G. Best published a list of the butterflies of Bombay and Salsette. Since then the list has been amended and added to by several authors (*JBNHS* 53:282, 54:215, 56:358, 57:233, 74:190, 76: 369). I now make five more additions to the list.

Lethe europa Fabricius—The Bamboo Treebrown. The nearest published record I can trace is from Matheran (Davidson, *JBNHS* 8:556). I took two specimens in the Borivli National Park on 2nd February 1975.

Zizula hylax (Fabricius)—The Tiny Grass Blue. Though this species is not included in the lists of Bombay butterflies, E. H. Aitken and E. Comber (A list of the Butterflies of the Konkan, *JBNHS* 15: 47) mention that it occurs in Bombay and Salsette. On 23rd January 1975 I took two specimens in the Borivli National Park.

Lampides boeticus (Linnaeus)—The Peablue. This butterfly was very abundant in the Borivli National Park on 9th February 1975. It was seen on the roadside, in bushes, and on the wet banks of the lakes. The Peablue is very common throughout India and was probably overlooked by Best.

Colotis eucharis (Fabricius)—The Plain Orange Tip. Though not included on the Bombay list there are three specimens in the Society's collection, collected by N. B. Kinnear in Bombay in 1972. I have a male specimen taken at Devnar (below Trombay Hill) on 14th February 1973.

Arnetta vindhiana vindhiana (Moore)—The Vindhyan Bob. I have a male specimen taken on 9th February 1975 in the Borivli National Park. The species has been recorded from Matheran (see Aitken and Comber, loc. cit., p. 53).

SALMAN ABDULALI

3, Reshma Apartments,
13 Pali Hill,
Bandra,
Bombay 400 050,
May 20, 1980.

26. STRANGE PRACTICE OF A CATERPILLAR

The incident recorded by A. S. Bhaduri (1980, *J. Bombay nat. Hist. Soc.*, 76 (2): 368) under this heading is by no means unusual. In fact it is the usual method adopted by all Hesperiid larvae to prevent their habitation being fouled by frass. They possess a special organ, a comb-like flap, at the anus with which they flip the pellet of frass well away from their domicile. The action is purely automatic.

The butterfly with 'white-spotted black wings' observed on the near-by wall was almost certainly the imago that had emerged from the *Curcuma*-feeding caterpillar, probably *Celaenorrhinus* sp.

D. G. SEVASTOPULO

P. O. Box 95617,
Mombasa,
Kenya,
July 15, 1980.

27. *VICIA MONANTHA* RETZ. AND *SPOROBOLUS AIROIDES* (TORR.) TORR.—NEW TO INDIAN FLORA

During botanical exploration of Bikaner and Churu districts (Western Rajasthan), two interesting plants namely *Vicia monantha* Retz. (*Papilionaceae*) and *Sporobolus airoides* (Torr.) Torr. (Gramineae) were collected. A perusal of relevant literature on the flora of India and studies at Central National Herbarium, Calcutta revealed that these are new additions to the flora of India. *Vicia monantha* Retz. (syn. *V. griffithii* Baker) had, however, been included in J. D. Hooker's FLORA OF BRITISH INDIA 2:178. 1876 on the basis of specimens collected from Punjab and Baluchistan (Rawal Pindae and Futteyjung: *Griffith* 1114, *Clarke* 105 CAL). *Sporobolus airoides* (Torr.) Torr., a native of North America, is said to be introduced into India during present century as a fodder grass (Bor. N. L.

Grass. Burm. Cey. Ind. & Pak. 627. 1960). No further reference is available for this taxon in Indian floras and the herbarium specimens representing it at Central National Herbarium, Calcutta are also from Mexico and United States of America. The natural population of *S. airoides* (Torr.) Torr. were noted during the present study at different places along Rajasthan Canal in Bikaner district.

Since, these species have not been recorded in Indian floras and are likely to be found in other regions, detail description of each taxon, based on Indian material, is given together with it complete synonymy, distribution, ecology and phenology. The herbarium specimens are deposited in the Herbarium of Botanical Survey of India, Jodhpur (BSJO) and Central National Herbarium, Howrah (CAL).

Vicia monantha Retz. Obs. Bot. 3 : 39. 1783; Post & Dinsmore, Fl. Syria Palest. & Sinai 1 : 423-424. 1932; Burt & Lewis in Kew Bull. 1949: 497-515. 1950; Tutin *et al.* in Fl. Europea 2: 133. 1968; Plitmann in Davis, Fl. Turkey 3: 296. 1970; Zohary, Fl. Palaest. 2: 199. f. 284. 1972; Townsend & Guest, Fl. Iraq 3: 521. 1974. *V. gracilis* Banks & Sol. ex Russ. Nat. Hist. Aleppo ed. 2. 2: 259. 1794. *V. cinerea* M. Bieb. Fl. Taur.—Cauc. 3: 470. 1819. *V. calcarata* Desf. var. *cinerea* (M. Bieb.) Boiss. Fl. Orient. 2: 590. 1872. *V. griffithii* Baker in Hook. f. Fl. Brit. Ind. 2: 178. 1876. *V. monantha* Retz. var. *cinerea* (M. Bieb.) Dinsm. Fl. Pal. ed. 2. 1: 424. 1932. *V. monantha* Retz. subsp. *cinerea* (M. Bieb.) Maire in Bull. Soc. Hist. Nat. Afr. Nord 31: 17. 1940 (Papilionaceae).

Annual climbing herbs, clothed with short, appressed and spreading silky hairs. Stem terete. Leaves alternate, 5-12 cm. long, pinnate; rachis ending into 2 to 3-fid tendrils; leaflets 12-18, scattered and paired, linear-oblong, 8-25 × 1-2 mm., obtuse, distinctly veined beneath; petiolules ± 1 mm. long. Stipules deltoid, deeply palmately laciniate. Racemes peduncled, not exceeding the leaves, laxly 2 to 4-flowered. Calyx-tube campanulate; upper teeth deltoid, lower ones linear. Corolla lilac, ± 1.3 cm. long. Style finely downy all round the tip. Pods flat, oblong, 2-3.5 × 0.6-1 cm., glabrous, 5 to 7-seeded. Seeds oblong-suborbicular, smooth. (*Roy* 2492 B; March 18th, 1976).

Habitat: Semidesertic, common weed in wheat and barley crops and fallow fields; Churu, Sujangarh.

Fl. & Fr.: January-March.

Distribution: W. and S. Europe, Cyprus, Syria, Lebanon, Palestine, Jordan, Egypt, Arabia, Kuwait, Bahrain, Turkey, Caucasus, Iran, Pakistan, Afghanistan, Central Asia (Turkmenia to Pamir-Alai), Mocaronesia and N. Africa (Morocco to Libya). The eastward migration of this taxon towards India is of phytogeographical interest.

Sporobolus airoides (Torr.) Torr. U.S. Rept. Expl. Miss. Pacif. 7: 21. 1856; Hitchock, Mannual Grass. United States 428-429. 1950; Bor, Grass. Burm. Cey. Ind. & Pak. 627. 1960; Gould & Box, Grass. Texas Coast. Bend 156. 1965; Gould, Grass. Texas 99. 1975. *Agrostis airoides* Torr. in Ann. Lyc. New York 1: 151. 1824. *Vilfa airoides* (Torr.) Trin. ex Steud. Nom. Bot. ed. 2. 2: 766. 1841. *Sporobolus diffusissimum* Buckl. in Proc. Acad. Nat. Sci. Phil. 1862: 90. 1862 (Gramineae).

Tufted perennials. Culms erect to spreading, 50-100 cm long. Leaf-sheaths pilose at the throat; ligules membranous, ciliate; blades flat, 12-40 × 2-4 mm., involute when dry. Panicles spreading, 20-40 × 15-25 cm.; branchlets naked at the base, with the spikelets aggregated along the upper half to two-third. Spikelets purplish-green, 2-2.5 mm. long, Glumes unequal; first glume 0.4-1.8 mm. long, falling towards maturity; second glume 1.2-2.8 mm. long. Lemma and palea as long as second glume. Palea splitted to the base at maturity. Anthers yellowish, 1.5-1.7 mm long. Caryopsis ± 1 × 0.7 mm., opaque with a reddish or blackish striated pericarp. (*Roy* 2154; September 24th, 1975).

Habitat: Semidesertic, common in sandy, gravelly, saline and alkaline soils. This shows its great range of adaptability to different soil types; Bikaner, Lunkaransar.

Fl. & Fr.: August-November.

Distribution: United States of America and Northern Mexico, as far south as San Luis Potosi.

We are grateful to the Director, Botanical Survey of India, Calcutta and Deputy Director, Arid Zone Circle, Botanical Survey of India, Jodhpur for the facilities provided during the course of the present study.

BOTANICAL SURVEY OF INDIA,
JODHPUR, RAJASTHAN,
November 13, 1979.

G. P. ROY[1]
V. SINGH

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[1] *Present address*: Botanical Survey of India, Central Circle, Allahabad.

28. *CROTALARIA LABURNIFOLIA* L.—A LITTLE KNOWN SPECIES FROM MAHARASHTRA STATE

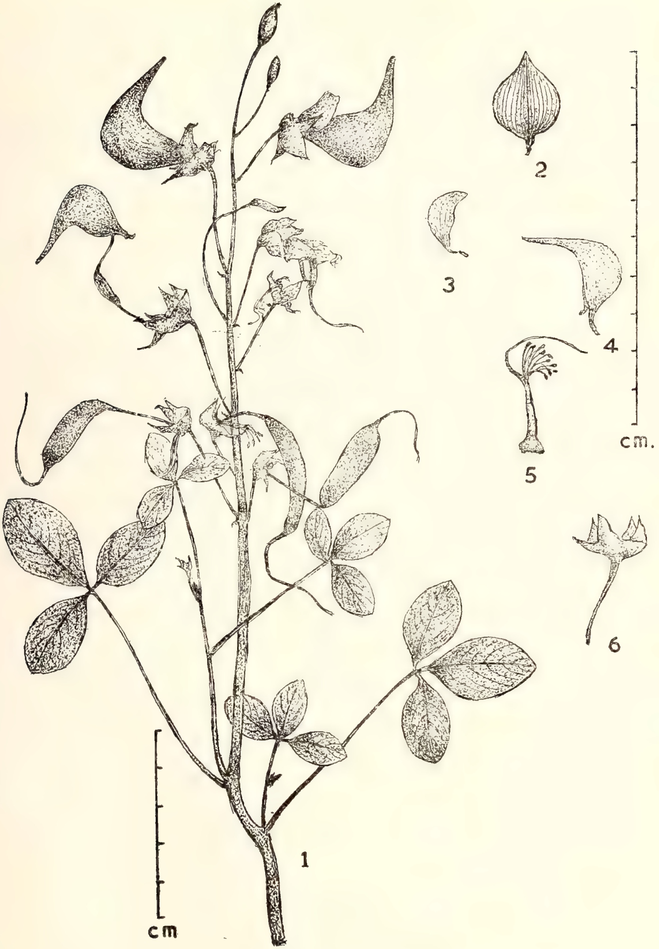
(*With six text-figures*)

Cooke (1901-08) included *Crotalaria laburnifolia* L. in his Flora of Presidency of Bombay on the authority of Dalzell & Gibson (1861) who in turn cited Nimmo (1839). But Nimmo did not indicate the precise locality for the plant except Southern Konkan ("S. Concan" vide Grah. Cat. 45. 1839). Cooke further stated that "It has not apparently been found by any other Bombay collector, and there are no specimens from Bombay in Herb. Kew. Woodrow did not include the plant in his list published in Journ. Bombay nat." Gamble (1916-35) recorded the species from N. Circars and Carnatic, especially near the coast, Deccan in Mysore; W. coast at Quilon, Travancore. From its general distribution along Western Peninsula, Ceylon, Philippines and Malay isles, it is obvious that it usually occurs along the sea shores and hence it is worthwhile to note the occurrence of this plant in Chandrapur district where it is located in the moist sandy soils of Pranhita river near Sironcha and thus confirms its specific occurrence in a precise locality in Maharashtra State.

In view of its rarity and the absence of any known published illustration for the plant, a line drawing is appended along with a brief description of the species.

Crotalaria laburnifolia L. Sp. Pl. 715, 1753; Baker in Hook. f. Fl. Brit. India 2: 84. 1876.

An undershrub or a low shrub. Leaflets membranous, glabrous cuneate at the base. Racemes lax, terminal and lateral. Pedicels exceeding the calyx. Calyx glabrous, turbinate; teeth as long as the tube. Corolla bright yellow, glabrous, keel very broad with a long



Figs. 1-6. *Crotalaria laburnifolia* L.
1. A flowering & fruiting twig; 2. Standard petal; 3. Vexillum (wing petal); 4. Karina (Keel petal); 5. Gynophore emerging out from the androecium sheath; 6. Persistent calyx.

incurved beak. Pod cylindrical, glabrous, long stalked, gynophore filiform much exceeding.

ACKNOWLEDGEMENTS

We are grateful to Dr. B. D. Sharma, Deputy Director, Western Circle, Botanical Survey India, Pune for encouragement and to the Director, Botanical Survey of India, Calcutta for providing the facilities.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE, PUNE 411 001,
October 30, 1979.

S. K. MALHOTRA
SIRASALA MOORTHY

29. *PENNISETUM PEDICELLATUM* TRIN.—A NEW FODDER GRASS ADDITION

(*With a text-figure*)

Pennisetum Rich. with over 130 species is distributed throughout the Tropics of the both old and new world and represents one of the largest genera of the Tribe Paniceae. *Pennisetum* section *pennisetum* includes pearl millet and millets, used for both grain and fodder purposes.

While working on the I.C.A.R. scheme "Eco-taxonomic studies of Fodder grasses of Kashmir with relation to productivity", we came across a few specimens of *Pennisetum pedicellatum* Trin.; hitherto unrecorded from this area. The species has been illustrated for reference. The voucher specimens have been deposited in the Herbarium, Kashmir University and Botanical Survey of India.

Flowering and *fruiting*: August to November.
Specimens collected: Mansbal, on rocky slopes, HT: 843, Chararishreef, on slopes, HT: 849, Darwan (Mahadave), on slopes, HT: 907, Gund. on steaps, HT: 1120.

POST-GRADUATE DEPT. OF BOTANY,
UNIVERSITY OF KASHMIR,
SRINAGAR 190 006,
KASHMIR,
October 10, 1979.

H. THAKUR
G. N. JAVEID

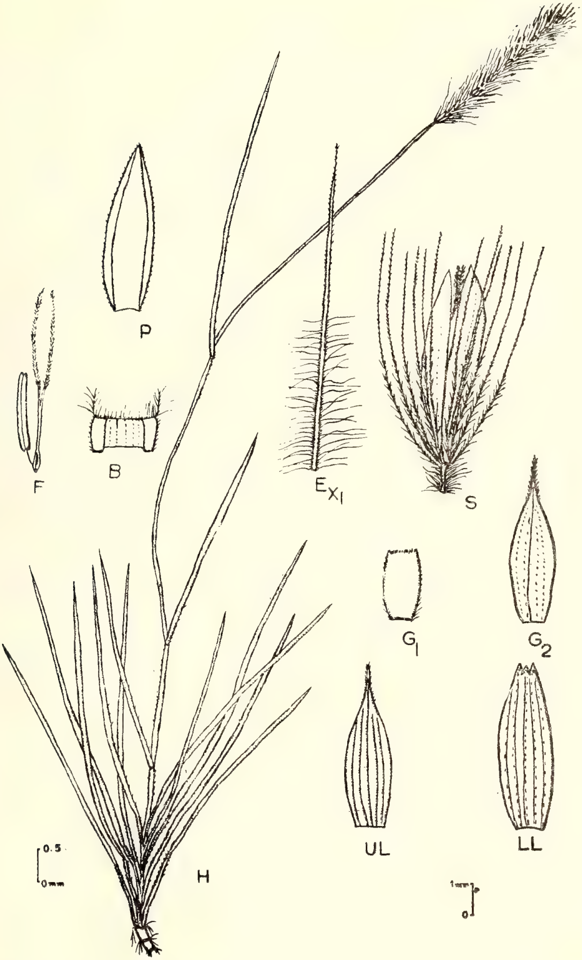

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Fig. 1. *Pennisetum pedicellatum* Trin.
H, Habit of plant; S, Spikelet; E, Bristle; B, Ligule; G_1, Lower glume; G_2, Upper glume; UL, Upper Lemma; LL, Lower Lemma; P, Palea; F, Flower.

30. *DAVALLIA FEJEENSIS* HOOK.—A NEW ADDITIONAL NATURALIZED ELEMENT TO THE INDIAN FLORA

During the course of a critical study of *Davallia* Sm. specimens housed in the Central National Herbarium, Botanical Survey of India, Howrah (CAL), one of us (N.C.N.) came across a specimen collected from Shevaroy Hills, Salem District, Tamil Nadu, by J. Ghatak. This specimen did not agree with other species of the genus so far reported from this country. On further examination, this turned out to be *Davallia fejeensis* Hook. Later, one of us (N.C.N.) collected it from the forest of Neyyar Dam area in Trivandrum District, Kerala. Hooker based this species on a specimen from Nukalau Island of the Fiji group. The sori of this taxon are very characteristic and probably the longest and narrowest in the genus.

Several new records of East Asiatic and Sri Lanka ferns have been recently reported from Peninsular India. *Asplenium grevillei* Wall. ex Hook. et Grev. (Nair & S. R. Ghosh 1978), *Doodia dives* Kuntze (Bhargavan 1973), *Loxogramme grammitoides* (Bak.) C. Chr. (Bhargavan & Joseph 1979), *Pteris heteromorpha* Fee (Nair & R. K. Ghosh 1978) and *Pteris tremula* R. Br. (Nair & S. R. Ghosh 1977) are some of those elements. The present discovery of *Davallia fejeensis* Hook. is another addition to the East Asiatic species naturalized in this country. No accurate information is available as to when this taxon was introduced in India. Beddome made extensive survey of ferns in Peninsular India but did not record it either in his Handbook (1883) or Supplement (1892). It may, therefore, be presumed that this must have been introduced here after 1892. Blatter and Almeida (1922) reported it as being grown in the Gardens of Bombay. This is probably the first report on the introduction of the species in India.

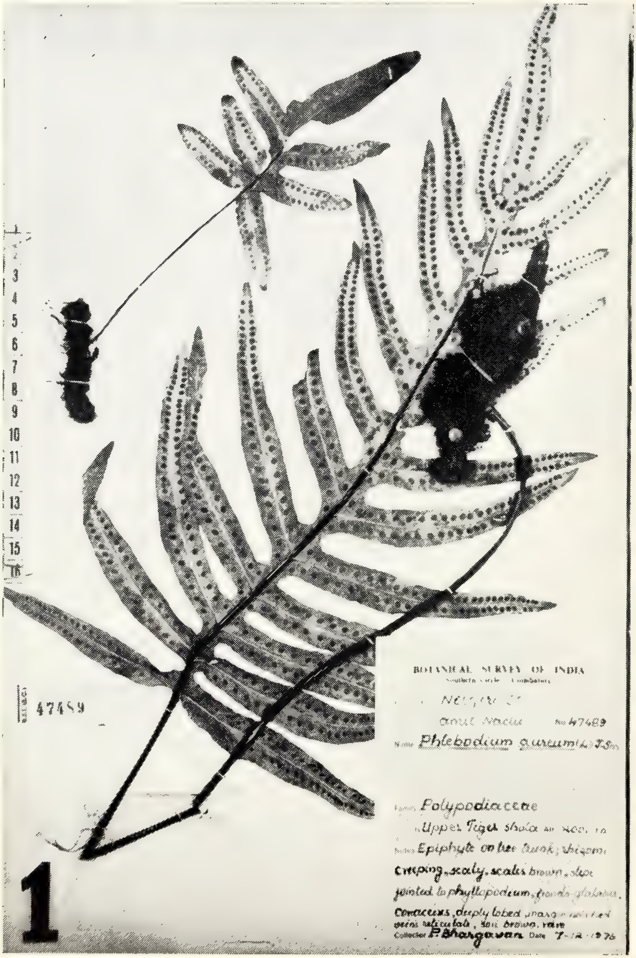
This taxon is often referred to as *Davallia fijiensis* and credit the authorship to W. J. Hooker (*see* Rosenburgh 1909, Bailey 1958). Hooker did not use the epithet *fijiensis*. It was Diels (in Die Naturlichen Pflanzenfamilien 1: 214. 1899) who used the spelling *fijiensis* which is not in accordance with Article 73 of the International Code of Botanical Nomenclature (Stafleu *et al.* 1978). Since Hooker has deliberately used the spelling *fejeensis*, it should be followed, although the specific epithet is after Fiji.

As no full description of this taxon is available in Indian literature, it is provided here based on our observations.

Davallia fejeensis Hook. Sp. Fil. 1: 166. t. 55 D. 1846; Hook. et Bak. Syn. Fil. 97. 1867 (ed. 2) 1874. *D. fijiensis* Diels Nat. Pflanzenfam. 1(4): 214. 1899; Rosenb. Handb. Fern Mal. Isl. 507. 1909.

Rhizome creeping, woody, ± 12 mm diameter, densely scaly; scales dark brown, fibrillose, base almost truncate, adpressed, apex long acuminate, margins ciliate. Stipes 15-25 cm long, stramineous, glabrous, glossy, strong, erect. Fronds coriaceous 30-40 cm long, 15-25 cm broad, deltoid, quadripinnatifid, pinnules of the lower pinnae deltoid-lanceolate, pinnule segments finely dissected to linear divisions. Sori semicylindrical, terminal on the deltoid apices of the divisions, indusium thrice as long as broad, semicylindrical.

Specimens examined: TAMIL NADU, Salem Dt., Shevroy Hills, *J. Ghatak* E 716, 28-8-1964 (CAL); Salem, *J. Ghatak* s.n. (CAL); KERALA, Trivandrum Dt., Forest near Neyyar Wild Life Sanctuary, 150 m, *N. C. Nair* 51537, 3.9.1978 (MH).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47489
BOTANICAL SURVEY OF INDIA
No. 47489
Phlebodium aureum (L.) J. Sm.
Polypodiaceae
Upper Tiger shola
Epiphyte on tree trunk; rhizome
creeping, scaly, scales brown,
jointed to phyllopodium, fronds glabrous,
coriaceous, deeply lobed
veins reticulate, sori brown, rare
Collector P. Bhargavan Date 7-12-1976

Phlebodium aureum (Linn.) J. Sm.

BOTANICAL SURVEY OF INDIA,
R. S. PURAM, COIMBATORE-2,
September 24, 1979.

N. C. NAIR
P. BHARGAVAN

REFERENCES

BAILEY, L. H. (1958): The Standard Encyclopedia of Horticulture I, New York. (repr. ed.).

BEDDOME, R. H. (1883): A Handbook to the Ferns of British India, Ceylon and the Malay Peninsula. Thacker Spink & Co., Calcutta.

———— (1892): A handbook to the Ferns of British India, Ceylon and Malay Peninsula with Supplement. Thacker, Spink and Co., Calcutta.

BHARGAVAN, P. (1973): Studies on South Indian Ferns—III, Notes on two rare and little known taxa. *Bull. bot. Surv. India 15* (3 & 4): 281.

———— & JOSEPH, J. (in Press): *Loxogramme grammitoides* (Bak.) C. Chr.—A fern record for India. *New Botanist.*

BLATTER, E. AND D'ALMEIDA, J. F. (1922): The Ferns of Bombay. Bombay

NAIR, N. C. & GHOSH, R. K. (1978): *Pteris heteromorpha* Fee—A new Record for India. *Indian Forester 104*: 374-376.

———— & GHOSH, S. R. (1977): *Pteris tremula* R. Br.—A new record for India. *J. Bombay nat. Hist. Soc.* 73: 240-241.

———— & ———— (1978): The rare fern *Asplenium grevillei* Wall. ex Hook. et Grev. (Aspleniaceae)—A new report for Peninsular India. *Indian Forester 104*: 819-822.

STAFLEU, F. A. *et al.* (1978): International Code of Botanical Nomenclature. Adopted by the Twelfth International Botanical Congress. Leningrad, July 1975. Bohn, Scheltema & Holkema. Utrecht.

VAN ROSENBURGH, C. R. W. K. VAN ALDERWERELT (1909): Malayan Ferns. Handbook to the determination of the Ferns of the Malayan Islands. Batavia.

31. *PHLEBODIUM AUREUM* (LINN.) J. SM. (POLYPODIACEAE)—A NEW RECORD FOR INDIA

(*With a plate*)

While critically studying the specimens of Polypodiaceae housed in the herbarium of Southern Circle, Botanical Survey of India (MH), our attenion was drawn to a specimen collected by K. M. Sebastine (4840) from Upper Tiger Shola, Nilgiri District, Tamil Nadu. The specimen was kept under *Pleopeltis nigrescens* Bl. This specimen is not with rhizome. Broadly lanceolate and deeply pinnatifid lamina, thickened and notched margins of the pinnae lobes, reticulate venation and areoles without included veinlets are characteristics of this specimen. Similar specimens were again collected with rhizomes from the same locality in Nilgiris, by one of us (P. Bhargavan). As the collections present in MH did not agree with the characters of any other member of the Polypodiaceae reported from India, a specimen was sent to the Central National Herbarium, Sibpur, Howrah (CAL), where it was identified as *Phlebodium aureum* (Linn.) J. Sm. The identity was later confirmed by the herbarium of the Royal Botanic Gardens, Kew.

Phlebodium aureum (Linn.) J. Sm. is an elegant, large and epiphytic fern, native to tropical America. It has become naturalised in the humid zones of Upper Tiger Shola in Nilgiris at an altitude of 2000 m. A plant brought by one of us (P. Bhargavan) and introduced in the garden of the Botanical Survey of India, Coimbatore, did not survive inspite of particular care. Probably this plant can survive only in the humid zones at higher altitudes unless controlled conditions are provided. A garden variety of the species is grown in the Fernery of Ooty Botanic Garden.

As this species has not been reported so far from India in a wild state and no description is available in the literature on Indian ferns, a detailed description is included here.

Phlebodium aureum (Linn.) J. Sm. Lond. Journ. Bot. 4: 59. 1841.

Polypodium aureum L. Sp. Pl. 2: 1087. 1753.

Epiphytes growing on tree trunks; rhizome creeping bearing a short phyllopodium to which the stipe is jointed; rhizome scales abundant, peltate, calthrate, deep brown at the place of attachment and light brown above, ± 12 mm long, ± 1-1.5 mm broad, lanceolate with a long accuminate tip, scale margins with unicellular emergences; stipe as long as the lamina or little shorter and wing-less, grooved, dull brown, glossy; lamina broadly lanceolate, 40-60 × 10-30 cm, dull brown, glossy; lamina broadly lanceolate, 40-60 × 10-30 cm, deeply pinnatifid; lateral lobes opposite or subopposite, 10-15 × 1-2 cm, 4-12 pairs, terminal lobe similar to lateral ones, apices acute, margins entire, thickened with equidistant notches; venation reticulate, areole without included veinlet; sori superficial, round, large, one on either side of the costa, median, seated at the junction of the veins; spores monolete, plano-convex in lateral view and oblong to elliptic in polar view, densely tuberculate.

Specimens examined: TAMIL NADU, Nilgiri District, Upper Tiger Shola, 2000 m, *K. M. Sebastine* 4840, 8-12-1957 (MH), *P. Bhargavan* 47489, 7-12-1976 (MH).

This plant may be mistaken for *Polypodium amomenum* Wall. ex Mett. but can be easily distinguished by the absence of paraphyses in the sporangium and included veinlet in the areoles.

ACKNOWLEDGEMENTS

We are thankful to the Director, The Royal Botanic Gardens, Kew, and to Mr. R. D. Dixit, Botanical Survey of India, Howrah for their help in the determination of the species.

BOTANICAL SURVEY OF INDIA,
SOUTHERN CIRCLE,
COIMBATORE-641 002,
July 24, 1979.

P. BHARGAVAN
N. C. NAIR

32. NOMENCLATURAL NOTES IN THE FAMILY LYCOPODIACEAE P. BEAUV. EX MIRB.

Holub (*Preslia* 47: 103, 1975) proposed the generic name *Lycopodiastrum* and gave diagnostic characters in English. The latin description is provided here to validate its publication and a new combination has been made for typification of the genus.

Lycopodiastrum Holub ex Dixit, gen. nov.

Planta divisa in parte sterile et in parte fertile cum fasciculis strobiloideorum. Caulis principalis gracilis, filo metallico similis, rigidus, usquae and 20 m longis. Folia matura monomorpha, squamis similia, plus minusive spiratum disposita. Sporae scarbatae.

Genus monotypicus.

Type species: **Lycopodiastrum casuarinoides** (Spring) Holub ex Dixit, comb. nov. *Lycopodium casuarinoides* Spring, Mem. Acad. Sci. Belg. 15(1): 92.1843.

A few more new combinations in the genera *Huperzia* Bernh. and *Phlegmariurus* (Herter) Halub have been established:—

Huperzia cryptomerina (Maxim) Dixit, comb. nov.—*Lycopodium cryptomerinum* Maxim, Bull. Acad. Sci. St. Petersb. 15:231. 1870.

Huperzia niligarica (Spring) Dixit, comb. nov.—*Lycopodium niligaricum* Spring, Bull. Acad. Sci. Belg. 15(1): 58.1843.

Huperzia petiolata (Clarke) Dixit, comb. nov.—*Lycopodium hamiltonii* var. *petiolata* Clarke, Trans. Linn. Soc. Lond. II Bot. 1: 590.1880.

Phlegmariurus phyllanthum (Hook. & Arn.) Dixit, comb. nov.—*Lycopodium phyllanthum* Hook. & Arn. Bot. Beech Voy. 102. 1841; Spring, Mem. Acad. Sci. Belg. 15(1): 73. 1843.

Love, Love and Pichi-Sermolli (Cytotaxonomical Atlas of the Pteridophyta p. 25. 1977) accepted the above name but did not provide bibliographical details and therefore, not validly published. However, Holub (personal communication, Feb. 1980) also did not validate its publication.

ACKNOWLEDGEMENTS

My grateful thanks thanks are due to Dr. S. K. Jain, Director, Botanical Survey of India, Howrah for the encouragement and to Dr. J. Holub, Botanical Institute, Praha, Czechoslovakia for providing the current information regarding nomenclature of his proposed genus and species. I am also thankful to Dr N. C. Majumdar, Botanical Survey of India, Howrah for Latin translation.

R. D. DIXIT

BOTANICAL SURVEY OF INDIA,
ALLAHABAD, U.P.,
July 22, 1980.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1978-79

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HONORARY SECRETARY'S REPORT FOR THE YEAR 1978

This report covers the activities of the Society in the 95th year of its existence

MEMBERSHIP

During the year 210 new members were enrolled. The total number of ordinary members who have paid their subscription for the year, has now crossed 800 and this trend we hope will continue. Your Committee is also making special efforts to increase membership, particularly Compound Corporate membership valid for 25 years, so that the Society can have a safe financial base. The objective is to have a Compound Corporate membership capital of a million rupees. This can be achieved if 1000 members of this category can be enrolled.

We have yet to receive subscription from 101 members and we have received resignations from 9 members. The number of members in each Class of membership as on 1st January is given below:

PUBLICATIONS

Journal

Three issues were published during the year, two of them (Vol. 74 No. 2 and Vol. 74 No. 3) being issues of the Journal for the previous year, and only one issue (Vol. 75 No. 1) relates to the current year.

The Journal unfortunately continues to be delayed in its publication. The articles continue to cover a wide range of subjects with emphasis on the ecology, behaviour and taxonomy of Indian fauna and the taxonomy and regional lists of Indian flora.

Diamond Jubilee issue of the Journal:

The journal for December 1978, now in press, is being published as a special issue as it completes 75 volumes of the Journal.

For a Natural History Journal published by a private society with hardly any financial

	1975	1976	1977	1978	1979
Ordinary members	578	531	512	541	640
„ corporate members	185	188	190	180	184
Life members	231	246	246	257	274
Compound Corporate members	1	1	1	2	9
Student members	20	10	20	39	96
Honorary members	4	4	4	4	4
Forest Dept. Nominees	90	36	—	—	—
					1207
Members elected in 1978, but not paid			23		
Members paid in 1977, but not paid for 1978			101		

support other than its own resources, this is indeed a commendable achievement.

Hornbill:

The *Hornbill* continues to serve the purpose of creating interest in natural history and in the activities of the Society. Four issues of the *Hornbill* were published during the year. It is hoped to make the *Hornbill* self supporting and we seek the assistance of members for advertisements for publication in the *Hornbill*.

Books:

During the year the following sales were made:

	Sales in		Balance stock
	1977	1978	31-12-1978
Book of Indian Birds	2894	3410	1696
Book of Indian Animals	479	29	32
India's Wildlife in 1959-70	319	154	4
Some Beautiful Indian Trees	235	133	2632
Glimpses of Nature in India Booklet	267	217	2289
Checklist of the Birds of Maharashtra	58	110	356

Books under preparation:

BOOK OF INDIAN ANIMALS.
(4th edition):

Prater's book on mammals continues to be the standard reference on Indian Mammals. It is now a recognized text for students taking wildlife courses at Universities in India. The text of the 4th edition, now in press, has been updated to include data published since the last edition of the book.

GRASSES OF WESTERN INDIA.
By T. Hodd (1st edition):

The book is the result of a two-year field study by the author in the Gir forest, Gujarat. It is designed as a handy field guide for the identification of Grasses of Western India. All the species described are illustrated.

The work on this new publication was continued during the year.

A SYNOPSIS OF THE BIRDS OF INDIA & PAKISTAN.
By Dillon Ripley (2nd edition):

The second revised edition of this definitive work on bird taxonomy of the Indian region covers the changes in thinking on the taxonomy of Indian birds since the first edition appeared in 1961. The book will be a required reference for any study on Indian birds.

The revised 2nd edition now in Press is expected to be ready by early 1980.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.
By Bor & Raizada (2nd edition):

The text of this book originally appeared as a series of papers in the Society's *Journal* between the years 1939 and 1948. The book deals with the wild and cultivated shrubs and climbers occurring in India and would be a excellent ready reference for members and others interested in the country's flora.

The second edition, now in the press, is expected to be ready in 1981.

Encyclopaedia:

As we had indicated in last year's report, the Society, with the assistance of the Department of Science & Technology, Govt. of India, is preparing for publication in the Centenary year of the Society an 'Encyclopaedia on Indian Natural History'. Steady progress is being maintained in the collection of material and several section editors are in the process of preparing the text for the Encyclopaedia.

CONSERVATION

The Society continued to take an active part in the Conservation Movement in the country through its association with State and Central Wildlife Boards, and through its members and staff serving on the International Union for Conservation of Nature and Natural Resources, the World Wildlife Fund, and the International Council for Bird Preservation.

Particular conservation projects in which the Society was specially interested or in which the Society's services were specially requested were:

Survey of Flamingo breeding colony:

Dr. Sálim Ali assisted by Mr. Lavkumar Khacher, a former Executive Committee Member, and Mr. M. A. Rashid, Addl. Chief Conservator of Forests (Wildlife), Government of Gujarat, made an aerial survey of the flamingo colony. The main objective was to delineate the area of the proposed sanctuary for breeding flamingos. The survey also reported the occurrence of a large colony of lesser flamingos. The Indian Airforce provided an helicopter for the survey.

Harike Lake in the Punjab:

At the invitation of the Wildlife Department of the Punjab Govt. the Curator, assisted by Mr. Shahid Ali, surveyed the Harike Lake area in Punjab to examine its potential as a wildlife refuge. A report has been submitted to the Govt. suggesting that the area could be named as a Wildlife Refuge as it offers excellent possibilities to study the conversion of a man made impoundment into a nature reserve. Financial assistance was received from World Wildlife Fund-India for the travel and the expenses in the study area were met by the Punjab Govt.

Crocodile Specialist Group meeting:

A meeting of the Crocodile Specialist Group of the Survival Service Commission of the I.U.C.N. was held at the Crocodile Bank in Madras in February. Crocodile Specialists from different parts of the World participated and India was represented by Society's Curator and Mr. Romulus Whitaker a member of the Society and Director of the Madras Snake Park. The group noted with satisfaction the progress that has been made in conservation of Indian crocodilians by governmental and non-governmental organisations. Part of the expenses incurred for the meeting were met by the Pirojsha Godrej Fund of the Society.

Asian Elephant Specialist Group:

The Survival Service Commission's Asian Elephant Group, which had the Society's Curator as a Co-Chairman conducted several status surveys and meetings of the group members in India to assess the data obtained from the Surveys. The studies are being funded by the World Wildlife Fund.

MEMBERS' ACTIVITIES

It has been possible to interest and encourage members in Bombay and elsewhere in field activities.

Bird count:

The monthly roadside count of birds which is held at the Borivli National Park on the last Sunday of each month continues to serve its purpose of training members in systematic bird-watching and the collection of data on the fluctuation in the bird fauna over a period of time. The bird count also helps members in interesting others in nature outings.

Nature walk:

This programme also assists in recruiting more members for the Society and in fostering interest in natural history among members and others.

Nature walks were organised in Borivli National Park and elsewhere for bird-watching, vegetation studies and general natural history. A large number of members participated.

Nature camp:

A camp was organised in July-August at the Valley of Flowers in Garhwal. 50 members participated in three groups led by Mr. Sumant Shah, Mr. S. A. Hussain and Mr. P. B. Shekar.

This programme has enabled the Society to take members on guided tours to areas of natural history interest. Similar programmes are scheduled for coming years.

RESEARCH AND OTHER ACTIVITIES FUNDED FROM FIELD WORK FUNDS

SALIM ALI/LOKE ORNITHOLOGICAL RESEARCH FUND:

During the year the fund supported the field studies of two research students with fellowship and assistance for contingencies. Miss Priya Davidar investigated the '*Ecology of specialised nectar feeding birds and bird flowers in the Nilgiris*'. Mr. S. A. Yahya, '*The Ecology of Barbets*'.

SALIM ALI CONSERVATION FUND:

Arunachal Pradesh survey: Partial assistance was extended from the fund for the survey of the fauna of Arunachal Pradesh by Drs. Sálim Ali and S. Dillon Ripley. A part of the collections, including birds, insects, and reptiles have been received at the Society and are now under study.

Wild Buffalo survey: Assistance was given to Mr. H. K. Divekar to investigate status of the Buffalo in peninsular India. This project is a follow up of the survey of the buffalo areas in peninsular India undertaken by the Society in 1965 with financial assitance from Govt. of Madhya Pradesh and which resulted in the formation of a wild buffalo sanctuary in Bastar. The present survey reports that the buffalo has now become more endangered.

PIROJSHA GODREJ FUND:

In addition to the support for the Crocodile Specialist group meeting the fund financed:

Nature Camp for under-privileged children: Children from Municipal schools in Bombay who are normally not in a position to go out on natural history field trips were taken to the Borivli National Park for a nature camp. The programme was organised under the Nature Education Scheme of the Society.

Hingolgadh Nature camp of the World Wildlife Fund:

Mr. R. J. Pimento, Technical Assistant at the Society, assisted at the Hingolgadh camp in the training of the camp members in the methods of bird banding and the use of mist nets.

Nature orientation camp:

Selected teachers from schools from Bombay were given a Orientation course on the methods of field study of natural history subjects. The camp was held at Borivli National Park.

Wild Dog study:

Assistant was given to Mr. John Singh to finalise his field investigation of the ecology of the wild dog at Bandipur. This study is mainly funded by the World Wildlife Fund.

Insects of valley of Flowers:

Advantage was taken of the nature camp of the Society in the Valley of Flowers, to depute the Society's entomologist Mr. N. C. Chaturvedi who made field observations and also collected insects concerned with flower pollination. A report is under preparation.

CHARLES MCCANN VERTEBRATE ZOOLOGICAL FUND:

Dr. J. H. Sabnis of the Marathwada University was offered assistance for studying '*Feeding habits of the common Indian Hare*'. His final report is awaited.

RESEARCH FUNDED BY GOVERNMENT AND GOVERNMENTAL AGENCIES:

DEPARTMENT OF SCIENCE & TECHNOLOGY, GOVT. OF INDIA

Computer analysis grant: The computer analysis of the data collected during the bird banding programme of the Society between the years 1967 and 1971 is now in progress. The data is being put on computer in the TIFR, Bombay and assistance in the organisation of the project is being received from the scientists at the TIFR. The work completed so far includes; the preparation of revised codes for 17 categories of information on each bird banded; the checking and sorting out of the entire ringing data; and data on over 100,000 words being fed into the computer.

INDIAN COUNCIL OF AGRICULTURAL RESEARCH:

'Determination of ecological disturbances in agricultural and adjoining lands caused by removal of *Rana tigrina* and *Rana hexadactyla* for export—A study by Mr. H. Abdulali.

The study was continued, and in this, the second year of the project, data on frog abundance and monthwise data on population, feeding, breeding, growth and other ecological factors were collected.

DONATIONS

For Pirojsha Godrej Fund from the Pirojsha Godrej Foundation	Rs.	10,000.00
For Sálim Ali Nature Conservation Fund		
Mr. E. W. Mudge	Rs.	684.51
For Charles McCann Field-work Fund		
Mr. S. Choudhuri	Rs.	600.00
Mr. Roger C. Whitman	Rs.	88.00

Other donations:

For Preparation of blocks for Book of Indian Birds 11th edition		
Dr. Sálim Ali	Rs.	3,000.00
For Zoological Records *General*		
Dr. Sálim Ali	Rs.	2,600.00

Mr. G. V. Bedekar	Rs.	1,000.00
Members of the Audubon Society, USA	Rs.	1,920.00
Cactus Society	Rs.	325.68
Other small donations	Rs.	385.00

REFERENCE COLLECTION

During the year 356 specimens were received at the society

Mammals	8
Birds	59
Reptiles	37
Amphibians	80
Insects	172
Total	356

Important additions are:
Catreas wallichii (chick) Donor S. R. Sane.

NATURE EDUCATION SCHEME

A circular regarding field trips and other activities was sent to 456 schools in Bombay at the beginning of the Academic year (This includes some schools from Thane also). 29 field trips to Borivli National Park were conducted during the year. This involved 1032 students. In addition a Teacher's training college was taken (80 teachers) for a day's field study; the blind school which had taken advantage of our field programme during the previous year arranged a day's field-trip this year also. A nature orientation course was arranged in November 1978 for 14 Biology Teachers.

During the year 23 visits to the Museum involving 1054 students, 12 visits to the Aquarium (339 students) and 8 visits to the Zoo (231 students) were arranged. 35 schools were visited personally. Students and teachers were encouraged in activities of natural history interest. Guidance was given to 12 schools on different topics of Natural History. 6 schools paid a donation to BNHS of Rs. 25/- each). 2 Radio talks on Nature Education were given during the academic year.

The scheme continues to be popular with schools in Bombay and Thane Districts and it has been possible to create an interest in nature among many of the students participating in field programmes.

MEETINGS

January, 7: *Talk*: 'Introduction to Birdwatching' by Dr. Robert B. Grubh.

January, 13: *Slide show*: 'India's magnificent Wildlife' by Mr. E. Hanumantha Rao.

February, 15: *Slide show*: 'The success story of Dalma Hill' by Mr. Ashok Kumar.

February, 17: *Talk*: 'Wildlife in Papua New Guinea' by Mr. John Lever.

July, 14: *Talk*: 'A botanist visits the Valley of Flowers' by Prof. P. V. Bole.

August, 30: *Lecture*: 'The Role of Vultures in the Ecology of East Africa' by Dr. David Houston.

August, 31: *Lecture*: 'Wildlife conservation in East Africa' by Dr. David Houston.

September, 20: *Slide show*: 'Valley of Flowers—an experience' by Mr. S. A. Hussain.

October, 12: *Film show*: 'Tiger Tiger Burning Bright'.

November, 24: *Film show*: 'Lokhande Wilderness'.

November, 29: *Lecture*: 'Ladakh—in search of the Black-necked Crane' by Mr. Prakash Gole.

December, 21: *Film show*: 1. 'Birds and animals of Japan'; 2. The Japanese Macaque; 3. 'Khairi'.

REVENUE & ACCOUNTS

The financial situation of the Society continued to be unsatisfactory. The year's operation showed a small surplus of Rs. 15,507.17 which has been adjusted against losses of Rs. 54,806.81 incurred in our operation over the years and carried on our books as deficit.

ACKNOWLEDGEMENTS

The Committee wishes to record its appreciation of the willing co-operation of the staff in the activities of the Society, and the special services rendered by some of the members.

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUST ACT 1950
SCHEDULE VIII VIDE RULE 17(1)

BALANCE SHEET FOR THE YEAR ENDED 31 *DECEMBER* 1978

FUNDS AND LIABILITIES		
Trust Fund on Corpus:		
Life Membership Fund:		
Balance as per last Balance Sheet	1,12,548.03	
Add: Amount received during the year	21,750.00	1,34,298.03
Fixed Assets Fund:		
Balance as per last Balance Sheet	65,473.20	
Add: Value of the fixed assets purchased during the year from Government of India grant	31,623.59	
	97,096.79	
Less: Transferred from Income and Expenditure account on account of depreciation for the year	9,638.79	87,458.00
General Reserve Fund:		
Balance as per last Balance Sheet		37,952.71
Building Fund:		
Balance as per last Balance Sheet	9,244.68	
Less: Transfer to Income & Expenditure Account	4,547.00	4,697.68
Publication Fund:		
Balance as per last Balance Sheet	82,550.53	
Add: Sale proceeds of Glimpses of Nature Booklet published under WWF/Volkart Foundation Grant	1,276.59	
Add: Donations for Blocks of Book of Indian Birds by Dr. Sálim Ali	5,000.00	88,827.12
Carried over		3,53,233.54

ASSETS		
Immovable Properties:		Nil
Investments: (At appropriated value)		
50, 8% Convertible Bonds each of Rs. 100/- of Ahmedabad Manufacturing & Calico Printing Co. Ltd. fully paid (market value Rs. 3,500/-)	2,130.20	
202, 8% Redeemable Bonds each of Rs. 116/- of Ahmedabad Manufacturing & Calico Printing Co. Ltd. fully paid (market value Rs. 16,362/-)	9,982.95	
Government Securities: (At cost)		
3% Conversion Loan 1946/86 of the face value of Rs. 25,000/- (market value Rs. 15,125/-)	25,000.00	
5½% Government of India Loan 2000 of the face value of Rs. 2,000/- (market value Rs. 1,790/-)	2,000.00	
In fixed deposit with Maharashtra State Road Transport Corporation Rs. 20,000/-	20,000.00	59,113.15
Motor Cars, Motor Cycle & Auto Cycle:		
Balance as per last Balance Sheet	11,618.65	
Less: Depreciation during the year	2,323.63	9,295.02
Furniture, Fixture and Equipment:		
Balance as per last Balance Sheet	57,701.93	
Add: Purchased during the year	32,716.09	
Carried over	90,418.02	68,408.17

FUNDS AND LIABILITIES		
Brought over		3,53,233.54
Other Earmarked Funds:		
As per Schedule ‘A’		8,14,788.01
Provision for Capital Losses:		
Balance as per last Balance Sheet		4,528.38
Provision for Depreciation on Investments:		
Balance as per last Balance Sheet		9,266.10
Liabilities:		
For Expenses	1,70,424.30	
„ Advance subscription	2,033.42	
„ Sundry Credit Balances	20,668.32	
„ Library deposits	250.00	1,93,376.04
Carried over		13,75,192.07

ASSETS		
Brought over		68,408.17
Furniture, Fixture and Equipment:		
(contd.) B./f.	90,418.02	
Less: Depreciation during the year	7,315.16	83,102.86
Loans: (unsecured considered good		
To Employees		190.00
Advances: (unsecured considered good)		
To Employees	1,564.59	
To others	1,369.89	2,934.48
Stocks: Publications (as per inventory taken and certified by the Curator)		67,795.65
Income Outstanding:		
Interest accrued	19,397.24	
Supplies & services	91,638.80	
Grant Govt. of India	45,000.00	
Grant Govt. of Maharashtra	79,000.00	2,35,036.04
Cash and Bank Balances:		
A. *In Current Account with*:		
i) Grindlays Bank Ltd., Mahatma Gandhi Road, Bombay	1,13,222.57	
ii) Grindlays Bank Ltd., London (£333.91 converted at Rs. 16.44)	5,489.48	
iii) Chartered Bank, Bombay	35,998.09	
In Savings Account with:		
i) Grindlays Bank Ltd., Mahatma Gandhi Road, Bombay	15,604.97	
ii) Bank of India, Museum Savings Branch, Bombay	56,710.12	
B. *Fixed Deposit with*:		
i) Bank of India, Bombay (consisting of Rs. 36,000/- of Dr. Sálim Ali/Loke Wantho Ornithological Research Fund and Rs. 3,000/- for Col. Burtons Nature Conservation Fund	39,000.00	
Carried over	2,66,025.23	4,57,467.20

FUNDS AND LIABILITIES		ASSETS		
Brought over	13,75,192.07	Brought over		4,57,467.20
		Cash and Bank Balances: (contd.) B./f.	2,66,025.23	
		ii) Chartered Bank, Bombay (including Rs. 30,000/- of Pirojsha Godrej Foundation Fund & Rs. 1,000/- of Dr. Sálim Ali Conservation Fund)	42,400.00	
		iii) Grindlays Bank, Bombay, including Rs. 60,000/- of Dr. Sálim Ali/Loke Wantho Ornithological Research Fund and Rs. 22,670/- of Charles McCann Vertebrate Zoology Field work fund	95,000.00	
		C. *In monthly Income Certificate with*: Bank of India consisting of Rs. 1,25,000/- of Dr. Sálim Ali/Loke Wantho Ornithological Research Fund and Rs. 3,50,000/- of Dr. Sálim Ali Nature Conservation Fund	4,75,000.00	8,78,425.23
		Income and Expenditure Account:		
		Balance as per last Balance Sheet	54,806.81	
		Less: Excess of Income over Expenditure as per Income & Expenditure account	15,507.17	39,299.64
Total	13,75,192.07	Total		13,75,192.07

Sd/- SALIM ALI,
President,
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary,
Bombay Natural History Society

As per our report of even date
Sd/- HABIB & Co.,
Chartered Accountants.

Sd/- C. V. KULKARNI,
Honorary Treasurer,
Bombay Natural History Society

Bombay, 12*th October*, 1979.

Schedule 'A'

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE FORMING THE PART OF BALANCE SHEET AS AT 31ST *DECEMBER*, 1978

Name of the Fund/Grant (1)	*Balances as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ refunded during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1978 (5 minus 8)* (9)
(1) Field Work Fund (Sir Dorabji Tata Trust)	2,169.14	—	—	2,169.14	—	—	—	2,169.14
(2) Staff Welfare Fund	2,244.33	—	—	2,244.33	—	—	—	2,244.33
(3) Dr. Sálim Ali/Loke Wantho Ornithological Research Fund	2,21,136.52	—	—	2,21,136.52	—	—	—	2,21,136.52
(4) Col. Burton's Nature Conservation Fund	4,175.34	300.00 (Interest)	—	4,475.34	—	—	—	4,475.34
(5) Charles McCann Vertebrate Zoology Field Work Fund	22,672.94	3,178.88 (including interest)	—	25,851.82	677.87	—	677.87	25,173.95
(6) Scholarship Fund under Dr. Sálim Ali/Loke Wantho Ornithological Research Fund Investment	4,454.82	22,100.00 (Interest)	—	26,554.82	18,186.55	—	18,186.55	8,368.27
(7) Grant Govt. of India, Dept. of Sc. & Technology for Plan expenditure for 1975-76, contd. 1976-77, contd. 1977-78, contd. 1978-79	37,823.60	25,000.00	—	62,823.60	46,838.49	—	46,838.49	15,985.11
(8) Govt. of India, Dept. of Sc. & Technology, grant for backlog of Journal printing expenses 1976-77, contd. 1977-78, contd. 1978-79	15,703.50	—	—	15,703.50	15,703.50	—	15,703.50	—
(9) Grant Govt. of India, Dept. of Sc. & Technology, for Encyclopedia of Natural History 1976-77, contd. 1977-78, contd. 1978-79			—	21,825.38	6,577.00	—	6,577.00	15,248.38
Carried over	3,32,205.57	50,578.88	—	3,82,784.45	87,983.41	—	87,983.41	2,94,801.04

Name of the Fund/Grant (1)	*Balances as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ refunded during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1978 (5 minus 8)* (9)
Brought over	3,32,205.57	50,578.88	—	3,82,784.45	87,983.41	—	87,983.41	2,94,801.04
(10) Govt. of India, Dept. of Sc. & Technology for steel cabinets 1977-78, contd. 1978-79	60,000.00	—	—	60,000.00	31,623.59	—	31,623.59	28,376.41
(11) Grant Govt. of India, Dept. of Sc. & Technology for publication 1977-78, contd. 1978-79	37,130.14	—	—	37,130.14	1,413.80	—	1,413.80	35,716.34
(12) Pirojsha Godrej Foundation Fund	20,000.00	10,000.00	—	30,000.00	—	—	—	30,000.00
(13) Grant Indian Council of Agricultural Research for Determination of Ecological disturbances in agricultural and adjoining lands caused by removal of *Rana tigrina* & *Rana hexadactyla* for export	1,201.76	24,960.00	68.69 (B.N.H.S.)	26,230.45	26,230.45	—	26,230.45	—
(14) Field Work Fund under Pirojsha Godrej Foundation Fund Investments	2,616.66	2,500.00 (Interest)	—	5,116.66	4,051.12	—	4,051.12	1,065.54
(15) Projector Fund received from Members	2,228.00	—	—	2,228.00	613.84	—	613.84	1,614.16
(16) Dr. Sálim Ali Conservation Fund	3,51,857.59	684.51	—	3,52,542.10	—	—	—	3,52,542.10
(17) Conservation Fund under Dr. Sálim Ali Conservation Fund Investment	12,526.63	35,185.00 (Interest)	—	47,711.63	30,685.38	—	30,685.38	17,026.25
(18) I.U.C.N. Elephant Survey Grant	1,536.62	42,109.00	—	43,645.62	31,072.75	—	31,072.75	12,572.87
(19) Indian Institute of Science, Bangalore for publication of special issue of journal	—	27,000.00	—	27,000.00	634.00 refund	—	634.00	26,366.00
Carried over	8,21,302.97	1,93,017.39	68.69	10,14,389.05	2,14,308.34	—	2,14,308.34	8,00,080.71

Name of the Fund/Grant (1)	*Balances as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of colums 2,3, & 4* (5)	*Spent/ refunded during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1978 (5 minus 8)* (9)
Brought over	8,21,302.97	1,93,017.39	68.69	10,14,389.05	2,14,308.34	—	2,14,308.34	8,00,080.71
(20) *Grant from Government of Maharashtra*:								
1. *Grant for* 1977-78								
For establishment & building maintenance	21,436.49	—	—	21,436.49	21,436.49	—	21,436.49	—
2. *Grant for* 1978-79								
For establishment and building maintenance	—	75,000.00	—	75,000.00	60,292.70	—	60,292.70	14,707.30
Total	8,42,739.46	2,68,017.39	68.69	11,10,825.54	2,96,037.53	—	2,96,037.53	8,14,788.01

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUST ACT 1950
SCHEDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER*, 1978

EXPENDITURE		
To *Expenses in respect of Properties*:		
Rates, taxes and cesses	—	
Repairs and maintenance	3,899.42	
Salaries	4,547.00	
Depreciation (By way of provision or adjusted)	—	8,446.42
,, *Building Maintenance Expenses*:		
(As per contra)		
Met out of the Maharashtra Govt. grant		
For 1977-78	512.95	
For 1978-79	8,000.00	8,512.95
,, *Establishment Expenses*:		
Salaries including D.A. etc. from Govt. of Maharashtra grant		
(As per contra)		
For 1977-78	20,923.54	
For 1978-79	52,292.70	
Salaries including D.A. etc. (other than above)	1,01,602.34	
Society's contribution to staff Provident Fund	5,779.00	
Payment for ex-gratia payment to retired employees	1,500.00	
Postages	4,274.80	
Printing and Stationery	7,996.09	
Advertisement	376.50	
Telephone charges	4,500.70	
Bank charges	701.85	
Carried over	1,99,947.52	16,959.37

INCOME			
By *Rent* (Accrued and realised)			Nil
,, Interest: (Accrued and realised)			
On securities	3,134.56		
Less: Income tax deducted at source	523.00	2,611.56	
On Fixed Deposits		66,143.86	68,755.42
,, *Donations*:			
In cash			3,630.76
,, *Towards Special Purpose*:			
Charles McCann Vertebrate Zoology Field Work Fund		688.00	
Sálim Ali Nature Conservation Fund		684.51	
Towards Block making for New edition of Book of Indian Birds Publication		5,000.00	
Towards Library book purchases		2,600.00	
Pirojsha Godrej Foundation Fund		10,000.00	18,972.51
,, *Grants*:			
a) *Govt. of Maharashtra*:			
1. for 1978-79 Establishment & Building maintenance		75,000.00	
2. for 1978-79 Educational Activity		4,000.00	
b) *Govt. of India*:			
Department of Science & Technology			
1. for 1978-79 Journal Printing expenses		20,000.00	
2. for 1978-79 Bird Data computer analysing study		25,000.00	
Carried over		1,24,000.00	91,358.69

	EXPENDITURE		
	Brought over		16,959.37
,,	*Establishment Expenses*: (contd.) B./f.	1,99,947.52	
	Meeting expenses including talks, film shows etc.	2,237.20	
	Conveyance & travelling expenses (local)	883.10	
	Motor car, Motor cycle repairs and maintenance	5,326.22	
	Society's rule books	1,200.00	2,09,594.04
,,	*Audit Fees*:		1,000.00
,,	*Amount Written off*:		
	a) Bad debts	337.86	
	b) Loan Scholarship	—	
	c) Irrecoverable rent	—	337.86
,,	*Miscellaneous Expenses*:		
	General charges	978.31	
	Insurance premium	209.00	
	Repairs to furniture & equipment	543.84	
	Fund raising	550.00	
	Foreign Exchange difference	416.58	2,697.73
,,	*Depreciation*:		
	On furniture & equipment	7,315.16	
	On motor cars, motor cycle & auto cycle	2,323.63	9,638.79
,,	*Amount Transferred to Reserve or Specific Funds*:		
	Grants transferred to relevant funds	1,93,435.00	
	Donations towards specific funds transferred to relevant account in the Balance Sheets	16,372.51	
	Sale proceeds transferred to publication fund account (Glimpses of Nature Booklets)	1,276.59	
	Carried over	2,11,084.10	2,40,227.79

	INCOME			
	Brought over			91,358.69
,,	*Grants*: (contd.) B./f.		1,24,000.00	
	c) Indian National Science Academy for 1978-79 Journal Printing expenses		3,500.00	
	d) Indian Council of Agricultural Research for 1978-79 Frog Project		24,960.00	
	c) Grant IUCN/WWF for Elephant Survey		42,109.00	
	f) Institute of Science, Bangalore received	27,000.00		
	Less: refund	634.00	26,366.00	2,20,935.00
,,	*Income from Subscriptions & Entrance Fees*:			
	Membership subscriptions		41,417.79	
	Student Membership subscriptions		800.00	
	Corporate Membership subscriptions		18,432.00	
	Subscription to Journal (Non members)		17,520.99	
	Entrance fees		6,700.00	84,870.78
,,	*Income from Publication*:			
	Journal sales		3,650.50	
	Glimpses of Nature Booklet		1,276.59	
	Checklist of Birds of Maharashtra		223.88	5,150.97
,,	*Surplus on Sale of Books*:			
	Book of Indian Birds		44,084.00	
	Book of Indian Animals		556.28	
	Some Beautiful Indian Trees		2,292.00	
	India's Wildlife in 1959-70		3,093.75	
	Identification of Poisonous snakes		220.00	
	Other publications		5,825.00	
	Nature calendars		40,789.78	96,860.81
	Carried over			4,99,176.25

EXPENDITURE		
Brought over		2,40,227.79
,, *Amount Transferred to Reserve or Specific Funds*: (contd.) B./f.	2,11,084.10	
Sale proceeds transferred to Charles McCann Vertebrate Zoology field work fund (Checklist of the birds of Maharashtra)	223.88	
Interest on fixed deposits transferred to respective funds	62,352.00	2,73,659.98
,, *Expenses on Objects of the Trust*:		
Education:		
from respective funds (as per contra)		
1. Expenses towards research scholarship & other expenses on ornithological research out of scholarship fund under Dr. Sálim Ali/Loke Wantho Ornithological Research Fund Investment	18,186.55	
2. Expenses on field staff salaries & other expenses relating to Bird Data analysing study out of grant Govt. of India, Dept. of Science & Technology, (including Rs. 10,000/- paid for publication on Gir Grass by Hodd)	46,838.49	
3. Expenses on publication out of Grant, Govt. of India, Dept. of Science & Technology 1977-78	1,413.80	
4. Expenses on Back issue of Journal printing met out of grant Govt. of India, Dept. of Science & Technology	15,703.50	
5. Expenses on steel cabinets for specimens out of grant Govt. of India, Dept. of Science & Technology	31,623.59	
Carried over	1,13,765.93	5,13,887.77

INCOME		
Brought over		4,99,176.25
,, *Miscellaneous Income*:		
Library fines	6.90	
Fees for the use of Society's transparencies	3,100.00	
Other receipts	394.34	6,501.24
,, *Administrative Fees*:		
For handling various projects during the year debited to respective funds		11,181.52
,, *Transfers*: (to specific funds)		
Depreciation of fixed assets transferred to fixed Assets fund (as per contra)	9,638.79	
Transfer from Building fund for building expenses	1,547.00	
Expenditure on Establishment & Building maintenance transferred to Government of Maharashtra (as per contra)	81,729.19	
Expenditure on specific objects transferred to relevant funds (as per contra)	2,16,674.34	3,09,589.32
Carried over		8,26,448.33

EXPENDITURE		
Brought over		5,13,887.77
,, *Expenses on Objects of the Trust*: (contd.) B./f.	1,13,765.93	
6. Expenses on Encyclopedia of Natural History out of grant Govt. of India, Dept. of Science & Technology	6,577.00	
7. Expenses on Frog Project met out of grant from Indian Council of Agricultural Research	26,230.45	
8. Expenses relating to:		
a) Publication of Hornbill Newsletter		
b) Grant for Wild Buffaloes survey		
c) Arunachal Pradesh trip expenses		
d) Library subscription & other sundry expenses met from interest on Sálim Ali Conservation Fund investment	30,685.38	
9. Expenses on IUCN/WWF Elephant Survey met out of grant from IUCN/WWF	31,072.75	
10. Expenses for Field Research under interest on Pirojsha Godrej Foundation Fund Investment	4,051.12	
11. Expenses incurred on Film projector met out of Projector fund	613.84	
12. Expenses for field studies under Charles McCann Vertebrate Zoology field work Fund	677.87	
B. Journal expenses	68,707.10	
Journal indexes	400.00	
C. Field study programmes and other field study trips	2,882.88	
Carried over	2,85,664.32	5,13,887.77

EXPENDITURE	
Brought over	8,26,448.33
Carried over	8,26,448.33

EXPENDITURE				INCOME	
Brought over			5,13,887.77	Brought over	8,26,448.33
,, *Expenses on Objects of the Trust*:					
(contd.) B./f.		2,85,664.32			
D. *Library Account*:					
Subscriptions	6,706.36				
Purchase of new books	1,894.24				
	8,600.60				
Add: Other library expenses, book binding etc.	1,611.84	10,212.44			
E. Maintenance of reference collection		1,176.63	2,97,053.39		
Excess of Income over expenditure transferred to Balance Sheet			15,507.17		
Total			8,26,448.33	Total	8,26,448.33

Sd/- SALIM ALI,
President,
Bombay Natural History Society

Sd/- C. V. KULKARNI,
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
Sd/- HABIB & CO.,
Chartered Accountants.

Sd/- C. V. KULKARNI,
Honorary Treasurer,
Bombay Natural History Society

Bombay, 12*th October*, 1979.

BOMBAY NATURAL HISTORY SOCIETY
NATURE EDUCATION SCHEME
RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER*, 1978

RECEIPTS		
To *Balance as at* 1st *January* 1978:		
With Grindlays Bank Ltd., Bombay on Current Account	1,306.35	
With Bombay Natural History Society, Bombay	13.10	
With Nature Education Organiser	200.00	1,519.45
,, *Grants*:		
Govt. of Maharashtra for the year 1977-78	11,092.00	
Dr. Sálim Ali Conservation fund	1,750.00	
Pirojsha Godrej Foundation fund	900.00	
Nature camp receipts	400.00	14,142.00
Sales of Nature Study Booklets		1,086.45
Total		16,747.90

PAYMENTS		
Salary Nature Education Organiser		9,632.90
Printing and Stationery		268.75
Field trip expenses for school children		2,718.11
General charges		1,571.20
Postage		168.55
Balance as at 31st December 1978		
i) With Bombay Natural History Society	1,099.55	
ii) With Grindlays Bank Ltd. Bombay on current account	756.95	
iii) Cash on hand with Nature Education Organiser	531.89	2,388.39
Total		16,747.90

Sd/- **Salim Ali**,
President,
Bombay Natural History Society

Sd/- **A. N. D. Nanavati**,
Honorary Secretary,
Bombay Natural History Society

Sd/- **C. V. Kulkarni**,
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
Sd/- **Habib** & Co.,
Chartered Accountants.

Bombay, 12*th October*, 1979.

MINUTES OF THE ANNUAL GENERAL MEETING HELD ON 7TH DECEMBER 1979 AT 6-30 p.m. AT HORNBILL HOUSE, BOMBAY

The following were present:

1. Mr. Humayun Abdulali
2. Mr. K. D. Gokhale
3. Dr. P. J. Deoras
4. Mr. G. V. Bedekar
5. Mr. D. J. Panday
6. Mr. Bansi Mehta
7. Dr. S. R. Amladi
8. Dr. C. V. Kulkarni
9. Dr. A. N. D. Nanavati
10. Mr. Vibhakar K. Paralkar
11. Br. A. Navarro
12. Mr. N. D. Sethna
13. Mr. Shahid Ali
14. Mr. M. S. Srinivasan
15. Mr. Sydney D'Souza
16. Miss E. Battrick
17. Mr. K. S. Dharmakumarsinhji
18. Miss M. M. Haribal
19. Mr. J. P. Irani
20. Mrs. D. S. Variava
21. Miss Shama Futehally
22. Prof. P. V. Bole
23. Dr. Sálim Ali
24. Mr. R. E. Hawkins
25. Mr. D. P. Bannerji
26. Mr. N. C. Chhaya
27. Mr. Bipin Chandriyani
28. Mr. Ulhas Rane
29. Mr. Chandrakant Wakankar
30. Mr. S. P. Godrej
31. Mr. J. H. Thakkar

The President (Dr. Sálim Ali) requested Mr. G. V. Bedekar, Vice President, to take the chair.

Agenda Item (1)—Report for 1978 (which is the 95th year of the Society's existence).

The Chairman asked the Honorary Secretary (Dr. A. N. D. Nanavati) to present the report* of the Committee for the year 1978. The Honorary Secretary stated that copies of the report being available to members, he would only draw attenion to the salient points of the report. He did this and also gave some account of the important activities of the Society during the year 1979 to date, including the two PL-480 research projects. The Chairman invited comments on the report, and the account.

Dr. P. J. Deoras asked for information about the nature camps. This was furnished by the Honorary Secretary who added that in order to give them field experience, staff for maintenance of the Society's collections was occasionally deputed to camps, without detriment to the work of maintenance. To the query of Dr. Deoras regarding the Wild Baffalo survey, the Honorary Secretary replied that Mr. Divekar's report on the survey was available in the Society's office for perusal of members.

Dr. Deoras and Mr. Humayun Abdulali commented on the slow progress and certain features of the Computer analysis of bird banding data. The Honorary Secretary and the Curator (Mr. J. C. Daniel) explained the mode of the analysis of the vast data, on the Tata Computer which was available for this work on "shared" time, during limited hours and which led to slow progress. It was explained that a statement of the objectives of the analysis has been prepared and would shortly be made available to members of the Executive Committee of the Society. The vast data has to be analysed with reference to a large number of variables (e.g. species, sex, size and age of the bird and year, date, time and place of banding and of recovery).

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* *See* p. 543.

Dr. Deoras referred to the frog study under the Indian Council of Agricultural Research and asked for information about the results. At the request of the Chairman, Mr. Humayun Abdulali, the Principal Investigator of the research project gave details of the data collected and their significance and outlined the conclusions reached in his report to the I.C.A.R. which is taking further action in the matter.

The Honorary Secretary stated that the two projects proposed for finance from PL-480 funds are:

1. Studies on the movement and population structure of the Indian avifauna; and
2. Avian biology research station at Keoladeo Ghana (Bharatpur).

The Honorary Secretary explained, in reply to Mr. Humayun Abdulali, that members of the Society interested in these and other research projects may study them and that offers of cooperation or participation by members would be welcome.

The Curator informed the meeting that the report on Harike Lake project, submitted to the Punjab government was available for perusal in the Society's office. Similarly the plan prepared regarding the project for study of bird hazards at aerodromes was available for perusal.

The committee's report for 1978 was approved.

Agenda Item (2)—*Balance Sheet and Statement of Accounts for 1978.*

The Honorary Treasurer (Dr. C. V. Kulkarni) presented these* and drew attention to the fact that though the income and expenditure statement for calendar year 1978 showed a small surplus of about Rs. 15,000/-, the balance sheet showed accumulated losses amounting to over Rs. 39,000/- at the end of 1978. He requested members to assist in improving the financial position of the Society, by securing donations, and enrolment of new members, particularly Corporate life members. The Chairman then invited comments on the accounts.

Mr. Humayun Abdulali repeated his suggestion that the Maharashtra government grant (of Rs. 75,000/- for 78-79) which is shown as a single amount for "Establishment and Building Maintenance" should be split up under the two heads of establishment and of building maintenance. The Honorary Treasurer stated that the suggestion has been examined carefully but could not be accepted because all these years the aggregate grant as received from the government has been shown in our accounts and it would not be feasible for us to break up the grant and show it separately under two heads in an arbitrary way.

Dr. Deoras enquired about the items of expenditure to cover Rs. 31,000/- and odd spent under "18 IUCN Elephant Survey Grant". The Curator explained that only actual travelling expenses are met from the grant and no salaries etc. are disbursed, as the investigators do honorary work; the Society however collects usual administration charges in respect of such grants and funds administered by it.

The accounts were approved.

Agenda Item (3)—*Appointment of Auditors.*

Dr. C. V. Kulkarni proposed and Mr. D. J. Panday seconded that Messrs Habib & Co. be appointed our auditors for the year 1979 on the same remuneration *viz.* one thousand rupees. The proposal was approved.

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* *See* p. 550.

The Chairman referred to the delay in holding annual general meetings—which take place long after the close of our year in December. Our accounts are ready for audit by April but at that time the auditors are busy with priority work of clients relating to the closing and new financial and tax years. We propose to persuade the auditors to take up our audit work by July each year, so that the annual general meeting could be held by September, if not August, as it used to be held some years ago.

Agenda Item (4)—*Election of the Executive Committee for two years 1979 and 80.*

The Chairman stated that as three nomination papers for the Executive Committee have been received in addition to the twelve persons recommended, an election will be necessary, under the rules. The names recommended by the outgoing committee are (apart from Secretary, Govt. of India, Dept. of Science & Technology)—

1. Mr. Humayun Abdulali
2. Dr. S. R. Amladi
3. Prof. P. V. Bole
4. Mr. Divyabhanusinh Chawda
5. Dr. B. Dasgupta
6. Mr. H. K. Divekar
7. Mr. David Fernandes
8. Dr. C. V. Kulkarni
9. Mr. Bansi Mehta
10. Dr. A. N. D. Nanavati
11. Mr. M. S. Srinivasan
12. Mrs. Dilnavaz Variava

The three nominations received are:

1. Dr. P. J. Deoras,
   Proposed by Dr. A. K. Joshee
   Seconded by Dr. (Mrs.) A. S. Mehta
2. Mr. G. S. Ranganathan
   Proposed by Mrs. P. H. Mukherjee
   Proposed by Mr. Vincent James

3. Mrs. Phillippa H. Mukherjee
   Proposed by Dr. A. S. Kothari
   Seconded by Dr. H. V. Shenoy

The new advisory committee will be chosen by the newly constituted Executive Committee.

It was explained, in reply to a query that the advisory committee does not hold meetings but its members are furnished with papers such as agenda, minutes, notes etc. of Executive Committee meetings and are consulted on important matters.

The ex-officio members (President and vice-Presidents) will continue in office for another year.

Agenda Item (5)—There being no other business, the Honorary Treasurer, at the request of the Chairman invited the attention of members to the financial position of the Society and the need to augment the revenues by all possible means, particularly donations and enrolment of new members. Enrolment of a large number of Corporate Life members would give a good financial base for the Society's activities. A thousand corporate life members would enable the Society to have a capital of ten lakh rupees, interest on which could be utilised for improved emoluments to the staff and vigorous prosecution of research, in several aspects of natural history and conservation. The cooperation of all present was sought in this matter, in view of inflation, rising costs and limited grants. Enrolment of members as Vice Patrons on payment of Rs. 5,000/- was also commended.

The meeting terminated with a vote of

thanks to the Chair.

In the postal ballot held on January 1980 the following were elected to the Executive Committee:

EXECUTIVE COMMITTEE

Mr. Humayun Abdulali
Dr. S. R. Amladi
Prof. P. V. Bole
Mr. Divyabhanusinh Chawda
Dr. B. Dasgupta
Mr. H. K. Divekar
Mr. David Fernandes
Dr. C. V. Kulkarni
Mr. Bansi Mehta
Dr. A. N. D. Nanavati
Mr. M. S. Srinivasan
Mrs. Dilnavaz Variava

ERRATUM

Vol. 76(1)—Behaviour of Hoolock Gibbon (*Hylobates hoolock*) during different seasons in Assam, India

On page 9, Table 3,

The corrected Table 3 is as under:

TABLE 3

HOOLOCK GIBBON TERRITORY SIZES COMPARED WITH OTHER GIBBON SPECIES

Species	Location	Territory Size (ha)		N	Source
		Mean	Range		
H. hoolock	North Assam	22	18-30	1	Tilson, this study
H. lar	North Thailand	26	12-41	3	Carpenter, 1940
H. lar	East Malaya	39	20-47	4	Ellefson, 1974
H. syndactylus	Central Malaya	25	15-35	2	Chivers, 1974
H. klossii	Mentawai Islands Indonesia	7	5-8	13	Tenaza, 1975
H. klossii	Mentawai Islands Indonesia	11	9-13	15	Tilson, in prep.

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater, 4th edition (reprint). 28 plates in colour by Paul Barruel and many other monochrome illustrations. Rs. 60.00
(*Price to members Rs.* 55)

The Ecology of the Lesser Bandicoot Rat in Calcutta, by James Juan Spillett. Rs. 10

Birds

The Book of Indian Birds, by Sálim Ali. 11th (revised) edition. 74 coloured and many monochrome plates. Rs. 60.00
(*Price to members Rs.* 55)

Checklist of the Birds of Maharashtra, by Humayun Abdulali. Rs. 2.50
(*Price to members Rs.* 2)

Checklist of the Birds of Delhi, Agra and Bharatpur, by Humayun Abdulali & J. D. Panday. Rs. 3.00

Snakes

Identification of Poisonous Snakes, Wall chart in Gujarati, and Marathi. Rs. 5

Plants

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 3rd edition (Reprint). Rs. 40.00
(*Price to members Rs.* 35)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. 2nd edition. (*in Press*)

Miscellaneous

Glimpses of Nature Series Booklets:

1. OUR BIRDS I (with 8 coloured plates) in Kannada Rs. 0.62
2. OUR BEAUTIFUL TREES (with 8 coloured plates) in Hindi Rs. 0.62
3. OUR MONSOON PLANTS (with 8 coloured plates) in Hindi and Marathi. Rs. 0.80
4. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, and Hindi Rs. 1.25

Glimpses of Nature in India (with 40 coloured plates) in English Rs. 7.50
(*Price to members Rs.* 5)

Back numbers of the Society's Journal. Rates on application.

The Society will gratefully accept back numbers of the *Journal*, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Entrance Fees:	
Ordinary and Life Members	Rs. 25
Student Members	Rs. 10
Subscription:	
(*a*) Ordinary individual Members	Rs. 50
(*b*) Ordinary Corporate Members	Rs. 100
(*c*) Ordinary Members resident outside India	Rs. 85
Life Members	Rs. 750 (Rs. 250 after 20 years)
Compound Corporate Members	Rs. 1500
Student Members (without Journal)	Rs. 10
Annual subscription to Journal	Rs. 105

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £ 5.50 should be paid annually to the Society's London Bankers—The Grindlays Bank Ltd., 13, St. James's Sq., London SW1Y 4LF. Account No. 1101091.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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